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VOYAGER 2 SATURN ENCOUNTER SPECIAL EVENTS TABLE 12 August, 1981

| Time (GMT)                | R (Rs) | Lat    | Event  |
|---------------------------|--------|--------|--|
| Monday, 24 August 1981    |        |        |  |
| 236 20:00                 | 27     | 15.4   | Expected Voyager 2 inbound bowshock crossing     |
| 236 21:09                 | 26     | 15.5   | Voyager 1 inbound bow shock crossing distance    |
| 236 23:41                 | 24.1   | 15.8   | Pioneer 11 inbound bow shock crossing distance   |
| 237 1:08                  | 23     | 16     | Voyager 1 inbound magnetopause crossing distance |
| 237 2:00                  | 22     | 16.3   | Expected Voyager 2 inbound magnetopause crossing |
| Tuesday, 25 August 1981   |        |        |  |
| 237 7:05                  | 19.5   | 17.4   | Titan L-shell crossing (L=20.3)                  |
| 237 8:33                  | 17.3   | 17.9   | Pioneer 11 inbound magnetopause crossing         |
| 237 17:00                 | 10.4   | 21.8   | Switch from Format A to Format B (L=12.1)        |
| 237 20:56                 | 7.1    | 25.4   | Rhea L-shell crossing (L=8.73)                   |
| 237 21:05                 | 7      | 26     | Peak 1 MeV proton flux expected inbound          |
| 237 23:39                 | 4.81   | 28.8   | Dione L-shell crossing (L=6.27)                  |
| 238 0:43                  | 3.95   | 29.5   | Maximum latitude excursion                       |
| 238 0:56                  | 3.8    | 29.4   | E ring outer edge crossing (L=5)                 |
| 238 1:02                  | 3.70   | 29.4   | Tethys L-shell crossing (L=4.89)                 |
| 238 2:04                  | 3.0    | 26.4   | E ring maximum (L=3.8)                           |
| 238 2:23                  | 2.9    | 24.3   | E ring inner edge (L=3.5)                        |
| 238 3:24:08               | 2.67   | 13.1   | Saturn innermost approach                        |
| 238 3:28                  | 2.68   | 12.0   | G ring crossing (L=2.8)                          |
| 238 3:43                  | 2.69   | 8.3    | Minimum L (L=2.75)                               |
| 238 4:07                  | 2.8    | 2.53   | G ring crossing - outbound (L=2.8)               |
| 238 4:18                  | 2.86   | 0      | Ring Plane Crossing. Latitude = 0                |
| 238 5:16                  | 3.4    | -10.8  | E ring inner edge crossing outbound              |
| 238 5:35                  | 3.6    | -13.5  | E ring maximum - outbound                        |
| 238 6:35                  | 4.62   | -20.8  | Tethys L-shell crossing                          |
| 238 6:41                  | 4.4    | -19.9  | E ring outer edge crossing - outbound            |
| Wednesday, 26 August 1981 |        |        |  |
| 238 7:43                  | 5.288  | -23.32 | Dione L-shell crossing (L=6.26)                  |
| 238 9:41                  | 6.98   | -29.59 | Rhea L-shell crossing (L=8.73)                   |
| 238 9:43                  | 7.0    | -26.63 | Peak outbound 1 MeV proton flux expected         |
| 238 12:30                 | 9.3    | -28.4  | Switch from Format B back to Format A (L=12.0)   |
| 238 19:50                 | 15.3   | -29.5  | Titan L-shell crossing (L=20.3)                  |
| Thursday, 27 August 1981  |        |        |  |
| 239 14:00                 | 29.2   | -29.4  | Expected outbound magnetopause crossing          |
| 240 3:00                  | 36.5   | -29.3  | Expected outbound bowshock crossing              |

R = distance from Saturn. 1 Rs = 60330 km.  
 Lat = magnetic latitude assuming a centered dipole with no tilt.  
 One way light time = 1 hour 26 minutes 33.5 seconds.  
 To convert to P.D.T., subtract 7 hours.

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3 parallel redundant systems :  
HET 1

Block I :

LET A  
LET B  
Rates 1 to 8, 17 to 20, 25  
Event Buffers for HET AS, HET BS, HET P, LET SL, LET SL\*

Block II :

HET 2  
LET C  
LET D  
Rates 9 to 16, 21 to 24, 26  
Event Buffers for HET AS, HET BS, HET P, LET SL, LET SL\*

TET :

TET  
Rates 28 to 30  
Event Buffer for TET

Blocks I and II are fully symmetrical. LET's A/B and C/D are fully symmetrical.

PHA Readout :

LET and HET

Sum  
A1 + LA3 + LB3  
C2 + C3 + C4  
A2 + B2  
C1 + LA2 + LB2  
C1 + C2 + C3  
B1 + LA1 + LB1

AS  
PHA3  
PHA2  
PHA1  
BS  
PHA3  
PHA2  
PHA1  
P  
PHA3  
PHA2  
PHA1  
LET  
PHA3  
PHA2  
PHA1

TET

D1  
D2  
PHA1  
PHA2

Gain switching in HET is done with S5 after each 480 rate readouts when in AUTO mode.  
High gain for S5 = 1

Approved \_\_\_\_\_

Date \_\_\_\_\_

2) Event Analysis

| Tag Bits :  | 1     | 2   | 3     | 4    | 5     | 6    | 7      | 8    | 9   | 10  | 11      | 12      |
|-------------|-------|-----|-------|------|-------|------|--------|------|-----|-----|---------|---------|
| HET AS      | C1    | C2  | C3    | C4   | slant | G2*  | G1.G2* | HG   | 0   | 0   | block   | caution |
| HET PS, PEN | C4    | C2  | C3    | C4   | slant | G2*  | G1.G2* | HG   | 0   | 1   | block   | caution |
| LET A/B     | slant | L3  | L2    | LB1  | DLA2  | DLB2 | DLB2   | DLA3 | 1   | 0   | block=0 | caution |
| LET C/D     | slant | L3  | L2    | LD1  | DLC2  | DLD3 | DLD2   | DLC3 | 1   | 0   | block=1 | caution |
| TET (1)     | D4L   | D4H | D2L   | D2H  | D3L   | D3H  | D4L    | D4H  | 1   | 1   | 0       | caution |
| TET (2)     | GA    | GB  | SD7/8 | AD4L | D5L   | D5H  | D6L    | D6H  | D7L | D7H | D8L     | GA + GB |

Block = 0 for block I, 1 for Block II.

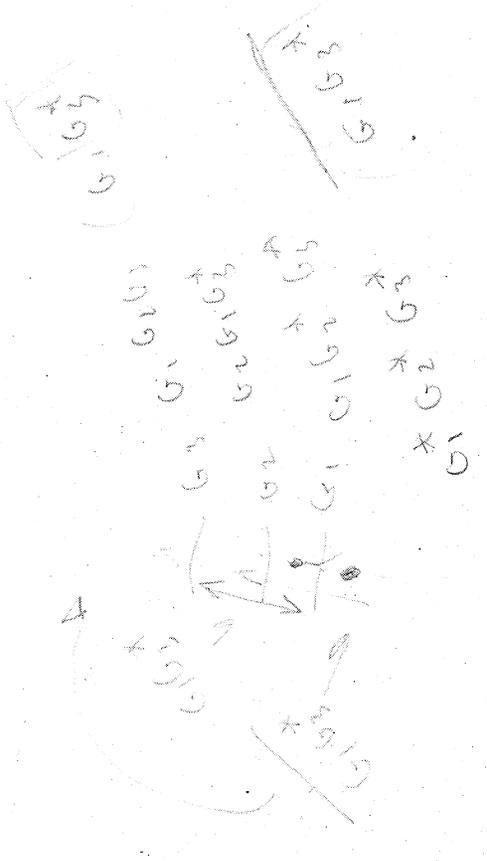
Caution flag = overflow in PHA or high gain/low gain switching in progress.

LET slants are Ored from 2 telescopes.

Polling: Each event type is stored in a separate 48-bit register dedicated to that event type. Each block has 5 registers. The TEI system has one register which may be sampled by either block. Between readouts, each block scans the event registers in the sequence LET SL\*, LET SL, HET AS, HET BS, LET SL\*, LET SL, HET PEN, TEI, stopping only at a full register. A separate two-level polling device toggles alternately between blocks if both have data available, or selects data from the appropriate block if only one has data. If both blocks are empty, a null event is readout (48 0's).

Word format:

|         |            |            |      |      |      |      |      |
|---------|------------|------------|------|------|------|------|------|
| 0       | 12         | 13         | 24   | 25   | 36   | 37   | 48   |
| HET/LET | TAG WORD   | PHA3       | PHA2 | PHA1 | PHA2 | PHA1 | PHA1 |
| TET     | TAG WORD 1 | TAG WORD 2 | PHA2 | PHA1 | PHA2 | PHA1 | PHA1 |



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MJS CFS SRD  
Electronics 2) Event Analysis

Block I Analysis Equations

```

HET AS :
low gain  R1.LA3*.LB3*.SAS*.NAA*.BPHA*
high gain A1.[A2].[C4].[G3].SA.LB2*.j.LA3*.LB3*.SAS*.NAA*.BPHA*
          A1.[A2].[C4].[G4].[B2].[B2].[LA3].LB3*.SAS*.NAA*.BPHA*

HET BS :
low gain  R2.LA1*.LB1*.SARP*.SARP*.NAB*.BPHA*
high gain [B1].[B2].[C1].[C3].SE2.[A2].LA1*.LB1*.NAB*.BPHA*
high gain [B1].[B2].[C1].[C4].[G4].[G4].[A2].LA1*.LB1*.NAB*.BPHA*
          [B1].[B2].[C1].[C4].[G4].[G4].[A2].LA1*.LB1*.NAB*.BPHA*

HET PEN :
R3.LA1*.LA3*.LB1*.LB3*.SAP*.NAP*.BPHA*
[B1].[B2].[C1].LA1*.LA2*.LB1*.LB2*.SAP*.NAP*.BPHA*

LET SL* :
R17.SALA*.NALI*.BHET1*.BLETP*.BPHA* + R19.SALB*.NALI*.BHET1*.BLETA*.BPHA*
LA1.[LA2].[LA3].LA4*.SLA*.NALI*.BHET1*.BLETB*.BPHA*
+ LB1.[LB2].[LB3].LB4*.SLB*.NALI*.BHET1*.BLETA*.BPHA*

LET SL :
R18.SALA*.NALI*.BHET1*.BLETB*.BPHA* + R20.SALB*.NALI*.BHET1*.BLETA*.BPHA*
LA1.[LA2].[LA3].LA4*.SLA*.NALI*.BHET1*.BLETB*.BPHA*
+ LB1.[LB2].[LB3].LB4*.SLB*.NALI*.BHET1*.BLETA*.BPHA*
    
```

TET analysis Equations

```

TET
R28.BTET*.SAT*.NAT*
[D4L].[D4H].[D2L].[D2H].[D2L].(D4L + AD4L*).(D7L* + SD7/8*).(D8L* + SD7/8*)
.[GA].[GB].[BET].[SAT].NAT*
    
```

Definitions:

Command bits  
SAS = Suppress AS mode  
SABP = Suppress Bsp mode  
SABE = Suppress Bse mode  
SAP = Suppress PEN mode  
SALA = Suppress LET A  
SALB = Suppress LET B  
SAT = Suppress TET

Strobe signals:

HST1 = HET 1 strobe = A1 + [B1] + [B2] + [C1] + [C4]  
LST1 = LET A strobe = L1  
LSTB = LET B strobe = LB1  
TST = TET strobe = [D1L] + [D2L] + [D3L] + [D4L.AD4L]

Busy flags  
BHET1 = A1 + B1 + C1  
BLETA = LA1 + LA2 + LA3  
BLETB = LB1 + LB2 + LB3  
BPHA = busy PHA  
NAA = AS register full  
NAB = BS register full  
NAT = TET register full  
NALI = LET SL register full  
NALII = LET SL register full  
BTET = TET PHA busy

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MJS CRS SRD  
Electronics 2) Rate System

Rate definitions

R1 = ASZ2.HG1# + AS.HG1  
 = A1.[A2].(SA + HG1).[C4#].([G1#].G2# + HG1#).([G3#] + HG1).[B2#].HST1  
 ASZ2 = A1.[A2].SA.[C4#].([G3#].[B2#]).HST1  
 AS = A1.[A2].[C4#].[G1#].G2#.[B2#].HST1  
  
 R2 = BSZ2.HG1# + BSP.(S1# + S2#).HG1 + BSe.(S1#.S2).HG1  
 = [B1].[B2].[C1#].([C4] + HG1# + S1# + S2#).(SB1 + HG1# + S1.S2).(SB1# + HG1# + S1# + S2#)  
 .(SB2 + HG1# + S1# + S2#).([G3#] + HG1).[A2#].HST1  
 BSZ2 = [B1].[B2].[C1#].SB2.[G3#].[A2#].HST1  
 BSP = [B1].[B2].[C1#].SE1.[G1#].G2#.[A2#].HST1  
 BSe = [B1].[B2].[C1#].[C4].SB1#.[G1#].G2#.[A2#].HST1  
  
 R3 = PEN = [B1].[B2].[C1].HST1  
  
 R4 = PEN.G0#  
  
 R5 = BS4Z2#.HG1#.S1 + BS4Z2.HG1#.S1# + BS4e.HG1.S1 + BS4p.HG1.S1#  
 = [B1].[B2].C3.[C4].G1#.(SB1# + HG1# + S1#).(SB1 + HG1# + S1#).(SB2# + HG1 + S1#).(SB2 + HG1 + S1#).HST1  
 BS4Z2# = [B1].[B2].C3#. [C4].G1#.SB2#  
 BS4Z2 = [B1].[B2].C3#. [C4].G1#.SB2  
 BS4e = [B1].[B2].C3#. [C4].G1#.SB1#  
 BS4p = [B1].[B2].C3#. [C4].G1#.SB1#  
  
 R6 = BSZ2#.HG1#.S1 + BSZ2.HG1#.S1# + BS2e.HG1.S1 + BS2p.HG1.S1#  
 = [B1].[B2].C2#.C3.[C4].G1#.(SB1# + HG1# + S1#).(SB1 + HG1# + S1#).(SB2# + HG1 + S1#).(SB2 + HG1 + S1#).HST1  
 BSZ2# = [B1].[B2].C2#.C3.[C4].G1#.SB2#.HST1  
 BSZ2 = [B1].[B2].C2#.C3.[C4].G1#.SB2.HST1  
 BS2e = [B1].[B2].C2#.C3.[C4].G1#.SB1#.HST1  
 BS2p = [B1].[B2].C2#.C3.[C4].G1#.SB1.HST1  
  
 R7 = BS2Z2#.HG1#.S1 + BS2Z2.HG1#.S1# + BS2e.HG1.S1 + BS2p.HG1.S1#  
 = [B1].[B2].C2.C3.[C4].G1#.(SB1# + HG1# + S1#).(SB1 + HG1# + S1#).(SB2# + HG1 + S1#).(SB2 + HG1 + S1#).HST1  
 BS2Z2# = [B1].[B2].C2.C3.[C4].G1#.SB2#.HST1  
 BS2Z2 = [B1].[B2].C2.C3.[C4].G1#.SB2.HST1  
 BS2e = [B1].[B2].C2.C3.[C4].G1#.SB1#.HST1  
 BS2p = [B1].[B2].C2.C3.[C4].G1#.SB1.HST1

Where HG1 = high gain bit for HET 1, and other definitions are on the preceding page.

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Date \_\_\_\_\_

MJS CRS SRD  
Electronics 3) Rate System

Rate definitions

R8 = singles, as listed in the rate table.

R17 = LA1.[LA2].[LA3].LA4\*.SLA\*.LSTA

R18 = LA1.[LA2].[LA3].LA4\*.SLA.LSTA

R19 = LB1.[LB2].[LB3].LB4\*.SLB\*.LSTB

R20 = LB1.[LB2].[LB3].LB4\*.SLB.LSTB

R25 = Singles, etc. as listed in the rate.

LATR = LA1.LA2.LA3.LA4\*.LSTA

LBTR = LB1.LB2.LB3.LB4\*.LSTB

R27 is spare accumulator.

R28 = [D1L].[D1H\*].[D2L].[D2H\*].(D4L + AD4L\*).(D7L\* + SD7/8\*).(D8\* + SD7/8\*).[CA\*].[GB\*].TST  
= TAN

R29 = TLO.S1\* + THI.S1  
= [D1L].[D1H\*].[D2L].[D2H\*].(D4L + AD4L\*).(D4H\*).(D5L + S1).D5H\*.(D6L\* + S1).D6H\*  
. (D7L + S1\* + SD7/8\*).(D7H\* + S1\*).[CA\*].[GB\*].TST  
TLO = [D1L].[D1H\*].[D2L].[D2H\*].(D4L + AD4L\*).(D4H\*).(D5L + S1).D5H\*.(D6L + S1).D6H\*.  
THI = [D1L].[D1H\*].[D2L].[D2H\*].(D4L + AD4L\*).(D4H\*).(D5L + S1).D5H\*.(D6L + S1).D6H\*.  
.D7H\*.D8L\*.[CA\*].[GB\*].TST

R30 = Singles, as listed in the rate table.

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Rate table

| SB | R1   | R2   | R3  | R4 | R5    | R6    | R7    | R8  | R17  | R18  | R19  | R20  | R25     | R28 | R29 | R30     |
|----|------|------|-----|----|-------|-------|-------|-----|------|------|------|------|---------|-----|-----|---------|
| 0  | ASZ3 | BSZ2 | PEN | PG | BS4Z2 | BS3Z2 | BS2Z2 | A1  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LA1     | IAN | TLO | D6L     |
| 1  | ASZ3 | BSZ2 | PEN | PG | BS4Z2 | BS3Z2 | BS2Z2 | A2  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LA2     | TAN | THI | GA + GB |
| 2  | ASZ3 | BSZ2 | PEN | PG | BS4Z2 | BS3Z2 | BS2Z2 | C1  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LA3     | TAN | TLO | D5H     |
| 3  | ASZ3 | BSZ2 | PEN | PG | BS4Z2 | BS3Z2 | BS2Z2 | C2  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LA4     | TAN | THI | D7L     |
| 4  | ASZ3 | BSZ2 | PEN | PG | BS4Z2 | BS3Z2 | BS2Z2 | B1  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LASL    | TAN | TLO | D6H     |
| 5  | ASZ3 | BSZ2 | PEN | PG | BS4Z2 | BS3Z2 | BS2Z2 | SA1 | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LBSL    | TAN | THI | D7H     |
| 6  | ASZ3 | BSZ2 | PEN | PG | BS4Z2 | BS3Z2 | BS2Z2 | SA2 | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LAI TRP | TAN | TLO | D5L     |
| 7  | ASZ3 | BSZ2 | PEN | PG | BS4Z2 | BS3Z2 | BS2Z2 | SB  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LBTRP   | TAN | THI | D8L     |
| 8  | ASZ3 | BSZ2 | PEN | PG | BS4Z2 | BS3Z2 | BS2Z2 | C3  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LB1     | IAN | TLO | D1H     |
| 9  | ASZ3 | BSZ2 | PEN | PG | BS4Z2 | BS3Z2 | BS2Z2 | C4  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LB2     | TAN | THI | D4H     |
| 10 | ASZ3 | BSZ2 | PEN | PG | BS4Z2 | BS3Z2 | BS2Z2 | B2  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LB3     | TAN | TLO | D2L     |
| 11 | ASZ3 | BSZ2 | PEN | PG | BS4Z2 | BS3Z2 | BS2Z2 | G1  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LB4     | TAN | THI | D3L     |
| 12 | ASZ3 | BSZ2 | PEN | PG | BS4Z2 | BS3Z2 | BS2Z2 | B1  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LASL    | TAN | TLO | D1L     |
| 13 | ASZ3 | BSZ2 | PEN | PG | BS4Z2 | BS3Z2 | BS2Z2 | SA1 | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LBSL    | TAN | THI | D3H     |
| 14 | ASZ3 | BSZ2 | PEN | PG | BS4Z2 | BS3Z2 | BS2Z2 | SA2 | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LAI TRP | TAN | TLO | D2H     |
| 15 | ASZ3 | BSZ2 | PEN | PG | BS4Z2 | BS3Z2 | BS2Z2 | SB  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LBTRP   | TAN | THI | D4L     |
| 16 | AS   | BSP  | PEN | PG | BS4p  | BS3p  | BS2p  | A1  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LA1     | IAN | TLO | D6L     |
| 17 | AS   | BSP  | PEN | PG | BS4p  | BS3p  | BS2p  | A2  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LA2     | TAN | THI | GA + GB |
| 18 | AS   | BSP  | PEN | PG | BS4p  | BS3p  | BS2p  | C1  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LA3     | TAN | TLO | D5H     |
| 19 | AS   | BSP  | PEN | PG | BS4p  | BS3p  | BS2p  | C2  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LA4     | TAN | THI | D7L     |
| 20 | AS   | BSP  | PEN | PG | BS4p  | BS3p  | BS2p  | B1  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LASL    | TAN | TLO | D6H     |
| 21 | AS   | BSP  | PEN | PG | BS4p  | BS3p  | BS2p  | SA1 | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LBSL    | TAN | THI | D7H     |
| 22 | AS   | BSP  | PEN | PG | BS4p  | BS3p  | BS2p  | SA2 | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LAI TRP | TAN | TLO | D5L     |
| 23 | AS   | BSP  | PEN | PG | BS4p  | BS3p  | BS2p  | SB  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LBTRP   | TAN | THI | D8L     |
| 24 | AS   | BSP  | PEN | PG | BS4p  | BS3p  | BS2p  | C3  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LB1     | IAN | TLO | D1H     |
| 25 | AS   | BSP  | PEN | PG | BS4p  | BS3p  | BS2p  | C4  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LB2     | TAN | THI | D4H     |
| 26 | AS   | BSP  | PEN | PG | BS4p  | BS3p  | BS2p  | B2  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LB3     | TAN | TLO | D2L     |
| 27 | AS   | BSP  | PEN | PG | BS4p  | BS3p  | BS2p  | G1  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LB4     | TAN | THI | D3L     |
| 28 | AS   | BSP  | PEN | PG | BS4p  | BS3p  | BS2p  | B1  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LASL    | TAN | TLO | D1L     |
| 29 | AS   | BSP  | PEN | PG | BS4p  | BS3p  | BS2p  | SA1 | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LBSL    | TAN | THI | D3H     |
| 30 | AS   | BSP  | PEN | PG | BS4p  | BS3p  | BS2p  | SA2 | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LAI TRP | TAN | TLO | D2H     |
| 31 | AS   | BSP  | PEN | PG | BS4p  | BS3p  | BS2p  | SB  | LAZ3 | LAZ3 | LBZ3 | LBZ3 | LBTRP   | TAN | THI | D4L     |

SB = Subcom state = S1 + 2.S2 + 4.S3 + 8.S4 + 16.S5  
 Rate table is for AUTO mode. When CRS is commanded to HG or HG# mode only the bottom  
 or top half is read out.  
 Note that there are actually two high gain bits.

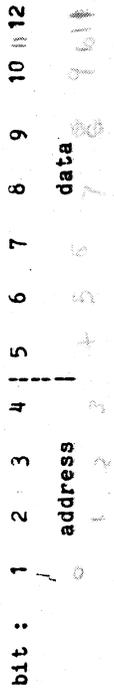
Approved \_\_\_\_\_ Date \_\_\_\_\_



| subcor<br>state | 0     | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11    | 12    | 13    | 14    | 15    |
|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| rate            | ASZ3  |
| accum           | BSZ2  |
| 1               | PEN   |
| 2               | PG    |
| 3               | BS4Z2 |
| 4               | BS3Z2 |
| 5               | BS2Z2 |
| 6               | A1    | A2    | C1    | C2    | B1    | SA1   | SA2   | SB    | C3    | C4    | B2    | G1    | B1    | SA1   | SA2   | SB    |
| 7               | ASZ3  |
| 8               | BSZ10 |
| 9               | PEN   |
| 10              | PG    |
| 11              | BS4Z2 |
| 12              | BS3Z2 |
| 13              | BS2Z2 |
| 14              | A1    | A2    | C1    | C2    | B1    | SA1   | SA2   | SB    | C3    | C4    | B2    | G1    | B1    | SA1   | SA2   | SB    |
| 15              | LAZ3  |
| 16              | LBZ3  |
| 17              | LCZ3  |
| 18              | LDZ3  |
| 19              | LA1   | LA2   | LA3   | LA4   | LA3   | LA2   | LA1   |
| 20              | LC1   | LC2   | LC3   | LC4   | LC3   | LC2   | LC1   |
| 21              | TAN   | THI   |
| 22              | TLO   | GA+GE | TLO   | THI   |
| 23              | D6L   | D5H   | D7L   | D6H   | D8L   | D7H   | D5L   | D8L   | D4H   | D4H   | D2L   | D3L   | D4L   | D3H   | D2H   | D4L   |
| 24              |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 25              |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 26              |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 27              |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 28              |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 29              |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 30              |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |

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Each 12-bit serial command consists of a 4-bit address code specifying a subsystem or device to be controlled, and 8 command data bits. Bit number 1 is the first bit transmitted, and is the MSB of the address code.



| Address | Use in command and/or status                      |
|---------|---|
| 0       | Status readout of some miscellaneous control bits |
| 1       | HET 1 preamps                                     |
| 2       | HET 2 preamps                                     |
| 3       | LET A/B preamps                                   |
| 4       | LET C/D preamps                                   |
| 5       | Block I PHA control                               |
| 6       | Block II PHA control                              |
| 7       | Block I analysis control                          |
| 8       | Block II analysis control                         |
| 9       | unused  |
| 10      | TET control                                       |
| 11      | TET preamps                                       |
| 12      | HET C preamps                                     |
| 13      | Miscellaneous control                             |
| 14      | unused  |
| 15      | unused  |

Status readout pattern duplicates commands exactly except for addresses 9 and 10. Address 0 is for status readout only. Address 10 has different bit order for command and status. See command/status table.

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Command/status table

|    | 0                                 | 1/2                   | 3/4              | 5/6                   | 7/8                 | cmnd                 | stat                 | 11              | 12                | 13                               |
|----|-----------------------------------|-----------------------|------------------|-----------------------|---------------------|----------------------|----------------------|-----------------|-------------------|----------------------------------|
| 5  | redundant<br>polling<br>indicator | A1 power<br>off       | LA1 power<br>off | Delete<br>LA2 terms   | Delete<br>LB2 terms | Disable<br>TET       | Add D4<br>terms      | D4 power<br>off | H4C1<br>power off | High Volt<br>redundant<br>enable |
| 6  | A2 power<br>off                   | LA2 power<br>off      | LA2 power<br>off | Delete<br>LA2 terms   | Delete<br>LB2 terms | Delete<br>W1 terms   | Delete<br>TET        | D2 power<br>off | H4C2<br>power off | Cal Stim<br>disable              |
| 7  | High Volt<br>enable<br>indicator  | B1 power<br>off       | LA3 power<br>off | Disable<br>HNP mode   | Delete<br>G* terms  | Delete<br>D3 terms   | Delete<br>GB* terms  | D3 power<br>off | H4C3<br>power off | redundant<br>polling             |
| 8  | HET 2<br>high gain<br>indicator   | B2 power<br>off       | LA4 power<br>off | Disable<br>HNPSE mode | Delete<br>C4 terms  | Subs D7L*<br>for D8* | Delete<br>GA* terms  | D4 power<br>off | H4C4<br>power off |                                  |
| 9  | HET 1<br>high gain<br>indicator   | C1 Guard<br>power off | LB1 power<br>off | Disable<br>HNPSE mode | Delete<br>C1 terms  | Delete<br>W2 terms   | Subs D7L*<br>for D8* | D5 power<br>off | H2C1<br>off       | H1 Gain<br>auto                  |
| 10 | Cal Stats<br>Q2 (MSB)             | C2 Guard<br>power off | LB2 power<br>off | Disable<br>HNPAS mode | Delete<br>B2 terms  | Delete<br>CB* terms  | Delete<br>D3 terms   | D6 power<br>off | H2C2<br>power off | H1 Gain<br>set high              |
| 11 | Cal Stats<br>Q2                   | C3 Guard<br>power off | LB3 power<br>off | Disable<br>LET E      | Delete<br>B1 terms  | Delete<br>GA* terms  | Delete<br>W1 terms   | D7 power<br>off | H2C3<br>off       | H2 Gain<br>auto                  |
| 12 | Cal Stats<br>Q1 (LSB)             | C4 Guard<br>power off | LB4 power<br>off | Disable<br>LET A      | Delete<br>A2 terms  | Add D4<br>terms      | Delete<br>W2 terms   | D8 power<br>off | H2C4<br>power off | H2 Gain<br>set high              |

#10  
C-10 STATUS  
110  
110  
110  
120

IMPORTANT STATUS/COMMANDS 0-8, 10-13 NOT 7, 14, 15

STATUS 0 IS SPECIAL

0 IS NOT CAL

10 CALS HAS TO BE RECALCULATED

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The cal sequence begins at the start of the first complete rate commutator cycle following receipt of the cal command. The sequence lasts for 8 complete commutator cycles (i.e. 8 x 16 x 30 = 3840 rate words, about 12.5 minutes at normal data rates) and turns off automatically. Data will not appear in telemetry until completion of the first accumulation interval within the commutator cycle (delay is 8 second minimum, 104 second maximum). HET, LET, and TET test pulses do not occur simultaneously but are separated by about 70 microseconds. Each occurs at a repetition rate of 3.6 kHz. There are a total of 10 separate cal buses which are pulsed separately and in combination, as shown in the table below. Coincidence rates stimulated are also listed; not shown are the appropriate singles in R8, R9, R25, R26, and R30. The rates which are not stimulated by this cal sequence are R7, R16, R17, R19, R21, and R23. Of these the last four (LET's without slants) can be stimulated by turning off the L3 preamps and disabling the L3 terms in the coincidence system.

cal busses on during cal period

| cal bus            | LG      | HG  | LG  | HG      | LG      | HG  | LG | HG | LG | HG      |
|--------------------|---------|-----|-----|---------|---------|-----|----|----|----|---------|
|                    | 1       | 2   | 3   | 4       | 5       | 6   | 7  | 8  | 9  | 10      |
| detectors          |         |     |     |         |         |     |    |    |    |         |
| A1, A2, C1, C3, SA |         | X   |     |         |         |     |    |    |    |         |
| B1, B2, C4         |         |     | X   |         |         |     |    |    |    |         |
| A1, A2, C1, C3, SA |         |     |     | X       |         |     |    |    |    |         |
| B1, B2, C4         |         |     |     |         | X       |     |    |    |    |         |
| D1, D2, D3, D4, D5 |         |     |     |         |         | X   |    |    |    |         |
| D6, D7             |         |     |     |         |         |     |    | X  |    |         |
| L1, L2, L3, SL     | X       |     |     |         |         |     |    |    |    |         |
| LET A CAL          |         | X   |     |         |         |     |    |    |    |         |
| LET B CAL          |         |     | X   |         |         |     |    |    |    |         |
| LET C CAL          |         |     |     | X       |         |     |    |    |    |         |
| LET D CAL          |         |     |     |         | X       |     |    |    |    |         |
| rates stimulated   | R18 R1  | R2  | R3  | R4      | R5      | R6  | R7 | R8 | R9 | R10 R11 |
|                    | R25 R20 | R5  | R4  | R22 R18 | R13     | R12 |    |    |    |         |
|                    | R28 R26 | R24 | R24 | R22 R18 | R14     |     |    |    |    |         |
|                    | R29     | R26 | R26 | R25 R24 | R20 R18 |     |    |    |    |         |
|                    |         | R28 | R26 | R25 R24 | R20     |     |    |    |    |         |
|                    |         | R29 | R28 | R26 R25 | R22     |     |    |    |    |         |
|                    |         |     | R29 | R28 R26 | R25     |     |    |    |    |         |
|                    |         |     |     | R29     | R26     |     |    |    |    |         |
|                    |         |     |     |         | R28     |     |    |    |    |         |
|                    |         |     |     |         | R29     |     |    |    |    |         |
|                    |         |     |     |         | R28     |     |    |    |    |         |
|                    |         |     |     |         | R29     |     |    |    |    |         |
|                    |         |     |     |         | R28     |     |    |    |    |         |
|                    |         |     |     |         | R29     |     |    |    |    |         |

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The CRS will internally multiplex 24 analog measurements onto a single CRS-FDS analog line. The multiplexer will be controlled by a simple modulo-24 counter which is advanced once by each two signals on the CRS-FDS Analog Mux Step line. The multiplexer is reset by a signal on the CRS-FDS Analog Mux Reset line. The 24 parameters to be sampled are:

| no. | name   | description                         |
|-----|--------|-------------------------------------|
| 1   | V(+10) | + 10 volt power supply voltage      |
| 2   | V(+6)  | + 6 volt "                          |
| 3   | V(+3)  | + 3 volt "                          |
| 4   | V(-3)  | - 3 volt "                          |
| 5   | V(-6)  | - 6 volt "                          |
| 6   | V(-12) | - 12 volt power supply voltage      |
| 7   |        |                                     |
| 8   |        |                                     |
| 9   |        |                                     |
| 10  | ILA    | LET A temperature                   |
| 11  | ILB    | LET B temperature                   |
| 12  | ILC    | LET C temperature                   |
| 13  | ILD    | LET D temperature                   |
| 14  | IHA    | HET 1 temperature                   |
| 15  | IHB    | HET 2 temperature                   |
| 16  | ITI    | TEI temperature                     |
| 17  | IPC    | Power converter temperature         |
| 18  | IPB    | Baseplate temperature               |
| 19  | IPHA   | PHA electronics temperature         |
| 20  | IH2    | HET2(left) side heater temperature  |
| 21  | IH1    | HET1(right) side heater temperature |
| 22  |        |                                     |
| 23  |        |                                     |
| 24  |        |                                     |

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Date \_\_\_\_\_

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# HIGH GAIN

| Particle         | A end        |                         | B end                   |                    |
|------------------|--------------|-------------------------|-------------------------|--------------------|
|                  | A1 (ch. no.) | C1+C2+C3 (ch. no.)      | B1 (ch. no.)            | C2+C3+C4 (ch. no.) |
| <sup>1</sup> H   | 6.9          | 65.0<br><del>65.0</del> | 20.6                    | 72.4               |
| <sup>4</sup> He  | 27.5         | 259.9                   | <del>20.6</del><br>82.2 | 289.8              |
| <sup>6</sup> Li  | 52.5         | 485.1                   | 156.2                   | 545.7              |
| <sup>7</sup> Be  | 77.5         | 727.8                   | 234.3                   | 805.9              |
| <sup>10</sup> Be | 98.6         | 849.4                   | 270.2                   | 945.2              |
| <sup>10</sup> B  | 117.2        | 1087.1                  | 351.7                   | 1218.6             |
| <sup>12</sup> C  | 155.6        | 1460.5                  | 473.6                   | 1606.3             |
| <sup>14</sup> N  | 201.3        | 1831.4                  | 606.2                   | 2051.7             |
| <sup>16</sup> O  | 246.7        | 2293.0                  | 751.1                   | 2536.2             |
| <sup>20</sup> Ne | 355.4        | 3226.7                  | 1074.7                  | 3625.6             |
| <sup>24</sup> Mg | 475.0        | 4330.2                  | 1449.4                  | 4811.7             |
| <sup>28</sup> Si | 608.5        | 5543.0                  | 1865.7                  | 6136.6             |
| <sup>32</sup> S  | 760.0        | 6791.9                  | 2323.0                  | 7580.3             |
| <sup>40</sup> Ar | 962.0        | 8488.4                  | 2921.9                  | 9574.9             |

## Sensitivities

|          | MeV/ch. |
|----------|---------|
| A1       | .046    |
| B1       | .178    |
| C1+C2+C3 | .860    |
| C2+C3+C4 | .860    |

# HET Endpoint Ch. Nos. - Low Gain

| <u>Particle</u>  | <u>A end</u>            |                           | <u>B end</u>        |                 |
|------------------|-------------------------|---------------------------|---------------------|-----------------|
|                  | <u>A1 (ch. no.)</u>     | <u>C1+C2+C3 (ch. no.)</u> | <u>B1 (ch. no.)</u> | <u>C2+C3+C4</u> |
| <sup>1</sup> H   |                         |                           |                     |                 |
| <sup>4</sup> He  | <del>10.5</del>         |                           |                     |                 |
| <sup>6</sup> Li  | 10.5                    | 97.0                      | 45.5                | 109.1           |
| <sup>7</sup> Be  | 15.5                    | 145.6                     | 68.3                | 161.2           |
| <sup>10</sup> Be | <del>17.7</del><br>22.1 | 169.9                     | 78.7                | 189.0           |
| <sup>10</sup> B  | 23.4                    | 217.4                     | 102.5               | 243.7           |
| <sup>12</sup> C  | 31.1                    | 292.1                     | 138.1               | 326.3           |
| <sup>14</sup> N  | 40.3                    | 366.3                     | 176.7               | 410.3           |
| <sup>16</sup> O  | 49.3                    | 458.6                     | 219.0               | 507.2           |
| <sup>20</sup> Ne | 71.1                    | 645.3                     | 313.2               | 725.1           |
| <sup>24</sup> Mg | 95.0                    | 866.0                     | 422.6               | 962.3           |
| <sup>28</sup> Si | 121.7                   | 1108.6                    | 543.9               | 1227.3          |
| <sup>32</sup> S  | 152.0                   | 1358.4                    | 677.2               | 1516.1          |
| <sup>40</sup> Ar | 192.4                   | 1697.7                    | 851.9               | 1915.0          |

## Sensitivities:

|          | MeV/ch.                 | <u>#G/LG Ratio</u> |
|----------|-------------------------|--------------------|
| A1       | 0.23                    | 5.0                |
| B1       | 0.61                    | 3.43 / Not c.      |
| C1+C2+C3 | <del>4.30</del><br>4.30 | 5.0                |
| C2+C3+C4 | <del>4.30</del><br>4.30 | 5.0                |

B2 is 1.22 MeV/ch.

# Rate

BCE rate is 80 PHA's/sec

Beam rep. rate at 503 MeV/N is ~~5/sec.~~ 5 seconds/pulse

Beam spill time is 0.6 sec

$$\Rightarrow 48 \text{ particles/beam pulse} \times \frac{1 \text{ pulse}}{5 \text{ sec}}$$

and 10 particles/sec

In a 10 min run, will accumulate  $\sim 6000$  particles

MUON RUN

~20 min

2/16/77 7 PM

| EN   | SC   | CL   | B1 - PEN | EVENT | TYPE | FROM | GAIN | SL | C1 | C2 | C3 | C4 |
|------|------|------|----------|-------|------|------|------|----|----|----|----|----|
| TAG  | PHA3 | PHA2 | PHA1     |       |      |      |      |    |    |    |    |    |
| 524  | 8    | 5    | 5        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 524  | 19   | 9    | 5        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 526  | 10   | 8    | 6        | HET   | PEN  | 1    | HI   | 0  | 1  | 1  | 1  | 1  |
| 526  | 12   | 13   | 7        | HET   | PEN  | 1    | HI   | 0  | 1  | 1  | 1  | 1  |
| 526  | 9    | 6    | 6        | HET   | PEN  | 1    | HI   | 0  | 1  | 1  | 1  | 1  |
| 524  | 7    | 5    | 5        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 524  | 8    | 3    | 5        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 526  | 11   | 6    | 7        | HET   | PEN  | 1    | HI   | 0  | 1  | 1  | 1  | 1  |
| 524  | 10   | 5    | 9        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 524  | 8    | 5    | 5        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 524  | 9    | 5    | 6        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 526  | 9    | 6    | 7        | HET   | PEN  | 1    | HI   | 0  | 1  | 1  | 1  | 1  |
| 524  | 15   | 5    | 8        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 526  | 16   | 11   | 6        | HET   | PEN  | 1    | HI   | 0  | 1  | 1  | 1  | 1  |
| 120  | 5    | 5    | 5        | HET   | AS   | 0    | HI   | 0  | 1  | 1  | 0  | 0  |
| 524  | 7    | 5    | 5        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 524  | 10   | 4    | 4        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 526  | 9    | 7    | 4        | HET   | PEN  | 1    | HI   | 0  | 1  | 1  | 1  | 1  |
| 526  | 9    | 6    | 4        | HET   | PEN  | 1    | HI   | 0  | 1  | 1  | 1  | 1  |
| 524  | 9    | 6    | 5        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 120  | 4    | 8    | 2        | HET   | AS   | 0    | HI   | 0  | 1  | 0  | 0  | 0  |
| 524  | 15   | 11   | 17       | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 524  | 11   | 5    | 7        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 526  | 13   | 9    | 8        | HET   | PEN  | 1    | HI   | 0  | 1  | 1  | 1  | 1  |
| 524  | 8    | 8    | 5        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 566  | 10   | 10   | 5        | HET   | PEN  | 1    | HI   | 0  | 1  | 1  | 1  | 1  |
| 524  | 2    | 9    | 9        | HET   | BS   | 0    | HI   | 0  | 0  | 0  | 0  | 1  |
| 7524 | 8    | 5    | 5        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 524  | 2    | 6    | 5        | HET   | BS   | 0    | HI   | 0  | 0  | 0  | 0  | 1  |
| 7524 | 16   | 5    | 4        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 3526 | 17   | 10   | 8        | HET   | BS   | 1    | HI   | 0  | 0  | 1  | 1  | 1  |
| 7524 | 9    | 5    | 4        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 7524 | 10   | 5    | 5        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 7524 | 8    | 6    | 7        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 7524 | 13   | 5    | 3        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 7526 | 9    | 6    | 6        | HET   | PEN  | 1    | HI   | 0  | 1  | 1  | 1  | 1  |
| 122  | 5    | 8    | 1        | HET   | AS   | 1    | HI   | 0  | 0  | 0  | 0  | 0  |
| 7524 | 9    | 4    | 8        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 7566 | 21   | 11   | 10       | HET   | PEN  | 1    | HI   | 0  | 1  | 1  | 1  | 1  |
| 7526 | 10   | 6    | 6        | HET   | PEN  | 1    | HI   | 0  | 1  | 1  | 1  | 1  |
| 7526 | 13   | 11   | 6        | HET   | PEN  | 1    | HI   | 0  | 1  | 1  | 1  | 1  |
| 3524 | 8    | 5    | 5        | HET   | BS   | 0    | HI   | 0  | 0  | 1  | 1  | 1  |
| 7524 | 10   | 6    | 6        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 7524 | 7    | 3    | 5        | HET   | PEN  | 0    | HI   | 0  | 1  | 1  | 1  | 1  |
| 0    | 0    | 0    | 0        | NULL  | ---- | -    | ---  |    |    |    |    |    |
| 0    | 0    | 0    | 0        | NULL  | ---- | -    | ---  |    |    |    |    |    |
| 0    | 0    | 0    | 0        | NULL  | ---- | -    | ---  |    |    |    |    |    |
| 0    | 0    | 0    | 0        | NULL  | ---- | -    | ---  |    |    |    |    |    |
| 0    | 0    | 0    | 0        | NULL  | ---- | -    | ---  |    |    |    |    |    |
| 0    | 0    | 0    | 0        | NULL  | ---- | -    | ---  |    |    |    |    |    |

A end it up,

AS A1 A2 3 C 16 HET 2's  
 BS 4 2 C B2 B1 28 HET 1's



OCTBL  
MASK

|      | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | OCTBL<br>MASK |
|------|---|---|---|---|---|---|---|---|---|----|----|----|---------------|
| AG2H | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0  | 0  | 0  | 153           |
| AG2C | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1  | 1  | 1  | 177           |
| AG2D | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0  | 0  | 0  | 143           |
| AG2E | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1  | 1  | 1  | 37            |
| AG2F | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0  | 0  | 0  | 60            |
| AG2G | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1  | 1  | 1  | 117           |
| AG2H | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0  | 0  | 0  | 63            |
| AG2I | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1  | 1  | 1  | 137           |
| BG2H | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1  | 0  | 0  | 124           |
| BG2I | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0  | 1  | 1  | 4053          |
| BG2J | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1  | 0  | 0  | 104           |
| BG2K | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0  | 1  | 1  | 1073          |
| BG2L | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1  | 0  | 0  | 164           |
| BG2M | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0  | 1  | 1  | 4013          |
| BG2N | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1  | 0  | 0  | 144           |
| BG2O | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0  | 1  | 1  | 4033          |
| BG2P | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1  | 0  | 0  | 64            |
| BG2Q | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0  | 1  | 1  | 4113          |
| BG2R | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1  | 0  | 0  | 41            |
| BG2S | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0  | 1  | 1  | 4133          |

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?

# HET PLOT PARAMETERS

| PLOT NAME | MASK |     | OFF MASK |     |                | XCH |                |     | YCH            |     |      | ZSH |      |     | XF         | YF | XF   | YF | XF | YF | HET1 - A/V | HET2 - A/V | HET1 - PEN | HET2 - PEN | HET1 - Σ C | HET2 - Σ C | HET1 - LG | HET2 - LG |
|-----------|------|-----|----------|-----|----------------|-----|----------------|-----|----------------|-----|------|-----|------|-----|------------|----|------|----|----|----|------------|------------|------------|------------|------------|------------|-----------|-----------|
|           | ON   | OFF | ON       | OFF | ON             | OFF | ON             | OFF | ON             | OFF | ON   | OFF | ON   | OFF |            |    |      |    |    |    |            |            |            |            |            |            |           |           |
| AS1H      | 20   |     | 17       |     | 1 <sup>2</sup> |     | 3 <sup>0</sup> |     | 2 <sup>1</sup> |     | 4096 |     | 4096 |     | HET1 - A/V |    | Σ C  |    | HG |    | HET1 - A/V |            | Σ C        |            | HG         |            | HET1 - LG |           |
| AS1L      | 0    |     | 37       |     | 1 <sup>2</sup> |     | 3 <sup>0</sup> |     | 2 <sup>1</sup> |     | 4096 |     | 4096 |     | "          |    | "    |    | LG |    | "          |            | "          |            | "          |            | LG        |           |
| BS1H      | 24   |     | 4013     |     | 3 <sup>0</sup> |     | 1 <sup>2</sup> |     | 2 <sup>1</sup> |     | "    |     | "    |     | "          |    | "    |    | HG |    | "          |            | "          |            | "          |            | LG        |           |
| BS1L      | 4    |     | 4033     |     | 3 <sup>0</sup> |     | 1 <sup>2</sup> |     | 2 <sup>1</sup> |     | "    |     | "    |     | "          |    | "    |    | HG |    | "          |            | "          |            | "          |            | LG        |           |
| AS2H      | 22   |     | 15       |     | 1 <sup>2</sup> |     | 3 <sup>0</sup> |     | 2 <sup>1</sup> |     | "    |     | "    |     | "          |    | "    |    | HG |    | "          |            | "          |            | "          |            | LG        |           |
| AS2L      | 2    |     | 35       |     | 1 <sup>2</sup> |     | 3 <sup>0</sup> |     | 2 <sup>1</sup> |     | "    |     | "    |     | "          |    | "    |    | HG |    | "          |            | "          |            | "          |            | LG        |           |
| BS2H      | 26   |     | 4011     |     | 3 <sup>0</sup> |     | 1 <sup>2</sup> |     | 2 <sup>1</sup> |     | "    |     | "    |     | "          |    | "    |    | HG |    | "          |            | "          |            | "          |            | LG        |           |
| BS2L      | 6    |     | 4031     |     | 3 <sup>0</sup> |     | 1 <sup>2</sup> |     | 2 <sup>1</sup> |     | "    |     | "    |     | "          |    | "    |    | HG |    | "          |            | "          |            | "          |            | LG        |           |
| PIH       | 4024 |     | 13       |     | 1 <sup>2</sup> |     | 2 <sup>1</sup> |     | 3 <sup>0</sup> |     | 4000 |     | 2048 |     | 4000       |    | 2048 |    | HG |    | "          |            | "          |            | "          |            | LG        |           |
| PIL       | 4004 |     | 33       |     | 1 <sup>2</sup> |     | 2 <sup>1</sup> |     | 3 <sup>0</sup> |     | "    |     | "    |     | "          |    | "    |    | HG |    | "          |            | "          |            | "          |            | LG        |           |
| POH       | 4026 |     | 11       |     | 1 <sup>2</sup> |     | 2 <sup>1</sup> |     | 3 <sup>0</sup> |     | "    |     | "    |     | "          |    | "    |    | HG |    | "          |            | "          |            | "          |            | LG        |           |
| POL       | 4006 |     | 31       |     | 1 <sup>2</sup> |     | 2 <sup>1</sup> |     | 3 <sup>0</sup> |     | "    |     | "    |     | "          |    | "    |    | HG |    | "          |            | "          |            | "          |            | LG        |           |
| AG3H      | 120  |     | 57       |     | 1 <sup>2</sup> |     | 3 <sup>0</sup> |     | 2 <sup>1</sup> |     | 4000 |     | 1096 |     | 4000       |    | 1096 |    | HG |    | "          |            | "          |            | "          |            | LG        |           |
| AG3L      | 100  |     | 77       |     | 1 <sup>2</sup> |     | 3 <sup>0</sup> |     | 2 <sup>1</sup> |     | "    |     | "    |     | "          |    | "    |    | HG |    | "          |            | "          |            | "          |            | LG        |           |

4E7G3

10/21/2017

| PRG NAME | V   | OFF | YCH            | YCH            | 3CH            | VF   | VF   | VF   | NET (CON)  |
|----------|-----|-----|----------------|----------------|----------------|------|------|------|--|
| AG2H     | 160 | 17  | 1 <sup>2</sup> | 3 <sup>0</sup> | 2 <sup>1</sup> | 100% | 4096 | 4096 | HET, AS, 4, 10, 20, 40, 80, 160, 320, 640, 1280, 2560, 5120, 10240, 20480, 40960, 81920, 163840, 327680, 655360, 1310720, 2621440, 5242880, 10485760, 20971520, 41943040, 83886080, 167772160, 335544320, 671088640, 1342177280, 2684354560, 5368709120, 10737418240, 21474836480, 42949672960, 85899345920, 171798691840, 343597383680, 687194767360, 1374389534720, 2748779069440, 5497558138880, 10995116277760, 21990232555520, 43980465111040, 87960930222080, 175921860444160, 351843720888320, 703687441776640, 1407374883553280, 2814749767106560, 5629499534213120, 11258999068426240, 22517998136852480, 45035996273704960, 90071992547409920, 180143985094819840, 360287970189639680, 720575940379279360, 1441151880758558720, 2882303761517117440, 5764607523034234880, 11529215046068469760, 23058430092136939520, 46116860184273879040, 92233720368547758080, 184467440737095516160, 368934881474191032320, 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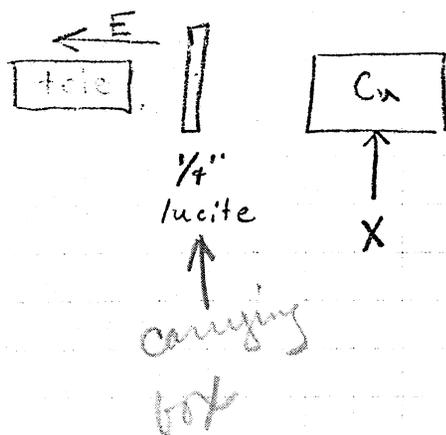
LET 1601 1601 1601

| PLOT NAME | NO<br>INCH | OFF<br>INCH | VCH | YCH            | ZCH | XF   | YF   | DESCRIPTION             |   |
|-----------|------------|-------------|-----|----------------|-----|------|------|-------------------------|---|
|           |            |             |     |                |     |      |      |                         |   |
| LA        | 10         | 407         | 3°  | 1 <sup>2</sup> | 2'  | 4096 | 4096 | LETB, 41 VS 13          |   |
| LB        | 410        | 7           | 3°  | 1 <sup>2</sup> | 2'  | "    | "    | LETB, 41 VS 13          |   |
| LC        | 12         | 405         | 3°  | 1 <sup>2</sup> | 2'  | "    | "    | LETB, 41 VS 13          |   |
| LD        | 413        | 5           | 3°  | 1 <sup>2</sup> | 2'  | "    | "    | LETB, 41 VS 13          |   |
| LAS       | 4010       | 407         | 3°  | 1 <sup>2</sup> | 2'  | "    | "    | LETB, 41 VS 13, 5/12/27 |   |
| LBS       | 4410       | 7           | 3°  | 1 <sup>2</sup> | 2'  | "    | "    | LETB "                  | " |
| LCS       | 4012       | 405         | 3°  | 1 <sup>2</sup> | 2'  | "    | "    | LETB "                  | " |
| LDS       | 4412       | 5           | 3°  | 1 <sup>2</sup> | 2'  | "    | "    | LETB "                  | " |

# Wedge

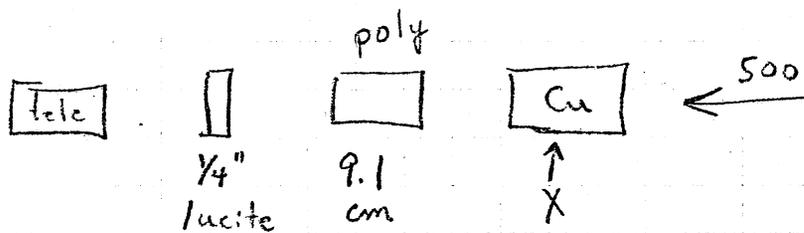
Range of 232 MeV/N Ar in Cu is 0.68 cm = 6.066 gm/cm<sup>2</sup>

Diam of Al 401 detector is:  $d = 2(A/\pi)^{1/2} = 2(8/\pi)^{1/2} = 3.19$  cm



$$R(500) = 2.357 \text{ cm}$$

| E   | X (cm Cu) |
|-----|-----------|
| 300 | 1.187     |
| 200 | 1.700     |
| 150 | 1.906     |
| 100 | 2.070     |
| 50  | 2.182     |



Cu steps are ( $\mu$ )

|    |     |      |       |
|----|-----|------|-------|
| 3  | 53  | 762  | 12294 |
| 6  | 107 | 1511 | 24587 |
| 12 | 183 | 3061 | 49149 |
| 24 | 394 | 6109 | 98300 |

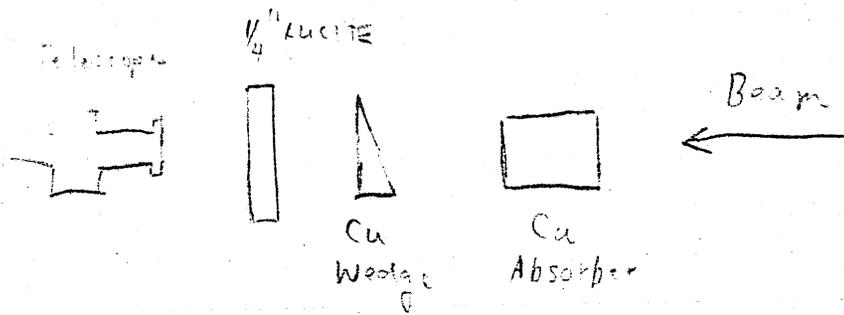
$$\Sigma = 196,535$$

1/4" lucite = 87.6 MeV Ar = 0.70 gm/cm<sup>2</sup> CH<sub>2</sub>

add 9.1 cm = 8.37 gm/cm<sup>2</sup>

0.70 + 8.37 = 9.07 gm/cm<sup>2</sup> = 298.5 MeV Ar = 14.18 cm Cu = 1589

| X<br>per Cu | 12294 | 6109 | 3061 | 1511 | 762 | 394 | 183 | 107 | 53 | 24 | 12 | 6 | 3 | #             |
|-------------|-------|------|------|------|-----|-----|-----|-----|----|----|----|---|---|---------------|
| 11870       | 0     | 1    | 1    | 1    | 1   | 1   | 0   | 0   | 0  | 1  | 0  | 1 | 1 |               |
| 17000       | 1     | 0    | 1    | 1    | 0   | 0   | 0   | 1   | 0  | 1  | 0  | 0 | 1 |               |
| 19060       | 1     | 1    | 0    | 0    | 0   | 1   | 1   | 0   | 1  | 1  | 0  | 0 | 1 |               |
| 20700       | 1     | 1    | 0    | 1    | 1   | 0   | 0   | 0   | 0  | 1  | 0  | 0 | 0 |               |
| 21820       | 1     | 1    | 1    | 0    | 0   | 0   | 1   | 1   | 1  | 0  | 1  | 0 | 0 |               |
| 7680        | 0     | 1    | 0    | 1    | 0   | 0   | 0   | 0   | 1  | 0  | 0  | 1 | 0 |               |
| 15500       | 1     | 0    | 1    | 0    | 0   | 0   | 0   | 1   | 0  | 1  | 1  | 0 | 1 |               |
| 19938       | 1     | 1    | 0    | 1    | 0   | 0   | 0   | 0   | 0  | 1  | 0  | 0 | 0 |               |
| 14567       | 1     | 0    | 0    | 1    | 1   | 0   | 0   | 0   | 0  | 0  | 0  | 0 | 0 |               |
| 11443       |       | 1    | 1    | 1    | 1   |     |     |     |    |    |    |   |   |               |
| 8014        |       | 1    |      | 1    |     | 1   |     |     |    |    |    |   |   |               |
| 11075       |       | 1    | 1    | 1    |     | 1   |     |     |    |    |    |   |   |               |
| 6399        |       | 1    |      |      |     |     | 1   | 1   |    |    |    |   |   | ⇒ B1-B2 Andry |
| 7031        |       | 1    |      |      | 1   |     |     | 1   | 1  |    |    |   |   | use for LET   |
| 13056       | 1     |      |      |      | 1   |     |     |     |    |    |    |   |   |               |
| 13805       | 1     |      |      | 1    |     |     |     |     |    |    |    |   |   |               |
| 10115       |       | 1    | 1    | 0    | 1   | 0   | 1   |     |    |    |    |   |   |               |
| 17260       | 1     |      | 1    | 1    |     | 1   |     |     |    |    |    |   |   |               |
| 18312       | 1     |      | 1    | 1    | 1   | 1   | 1   | 1   |    |    |    |   |   |               |
| 18403       | 1     | 1    |      |      |     |     |     |     |    |    |    |   |   |               |
| 18990       | 1     | 1    |      |      |     | 1   | 1   |     |    |    |    |   |   |               |



$\frac{1}{4}$ " Lucite = 87.6 MeV = .129 cm Cu  
 Add .68, subtract from 2.357  
 leaves 1.55

MUON RUN  
 LBL 2/17/77 1630hr  
 A end up

|      |    |      |    |      |   |
|------|----|------|----|------|---|
|      |    | HET  | 91 |      |   |
| HET1 | 47 |      |    |      |   |
| AS   | 9  | ASA2 | 9  | BSB2 | 0 |
| BS   | 3  | ASC1 | 0  | BSC4 | 1 |
| P    | 35 | ASC2 | 0  | BSC3 | 1 |
|      |    | ASC3 | 0  | BSC2 | 1 |
| HET2 | 44 |      |    |      |   |
| AS   | 1  | ASA2 | 1  | BSB2 | 0 |
| BS   | 2  | ASC1 | 0  | BSC4 | 2 |
| P    | 41 | ASC2 | 0  | BSC3 | 0 |
|      |    | ASC3 | 0  | BSC2 | 0 |

|      |   |      |   |
|------|---|------|---|
|      |   | LET  | 0 |
| LETA | 0 |      |   |
| SL   | 0 | NSL  | 0 |
| L1SL | 0 | L1NS | 0 |
| L2SL | 0 | L2NS | 0 |
| L3SL | 0 | L3NS | 0 |

|      |   |      |   |
|------|---|------|---|
| LETB | 0 |      |   |
| SL   | 0 | NSL  | 0 |
| L1SL | 0 | L1NS | 0 |
| L2SL | 0 | L2NS | 0 |
| L3SL | 0 | L3NS | 0 |

|      |   |      |   |
|------|---|------|---|
| LETC | 0 |      |   |
| SL   | 0 | NSL  | 0 |
| L1SL | 0 | L1NS | 0 |
| L2SL | 0 | L2NS | 0 |
| L3SL | 0 | L3NS | 0 |

|      |   |      |   |
|------|---|------|---|
| LETD | 0 |      |   |
| SL   | 0 | NSL  | 0 |
| L1SL | 0 | L1NS | 0 |
| L2SL | 0 | L2NS | 0 |
| L3SL | 0 | L3NS | 0 |

|     |   |      |   |    |   |
|-----|---|------|---|----|---|
|     |   | TET  | 0 |    |   |
| NUT | 0 | MXUT | 0 | UT | 0 |
| D3  | 0 |      |   | D3 | 0 |
| D4  | 0 | D4   | 0 | D4 | 0 |
| D5  | 0 | D5   | 0 | D5 | 0 |
| D6  | 0 | D6   | 0 | D6 | 0 |
| D7  | 0 | D7   | 0 | D7 | 0 |

CUMULATION TIME 3360.00 SECONDS

MUON RUN  
 LBL 2/17/77 1630hr

|     | TOTAL | CNTS/SEC |        | TOTAL | CNTS/SEC |
|-----|-------|----------|--------|-------|----------|
| A   | 9     | .00      | R18    | 0     | .00      |
| B   | 0     | .00      | R19    | 0     | .00      |
| B   | 0     | .00      | R20    | 0     | .00      |
| B   | 3     | .00      | R21    | 0     | .00      |
| C   | 0     | .00      | R22    | 0     | .00      |
|     | 35    | .01      | R23    | 1     | .00      |
|     | 32    | .00      | R24    | 0     | .00      |
| A   | 0     | .00      | R25LA1 | 2     | .00      |
| B   | 1     | .00      | LA2    | 1     | .00      |
| A   | 0     | .00      | LA3    | 1     | .00      |
| B   | 1     | .00      | LA4    | 15    | .07      |
| A   | 0     | .00      | SLA    | 0     | .00      |
| B   | 1     | .00      | SLB    | 0     | .00      |
| A1  | 50    | .23      | AL1234 | 0     | .00      |
| A2  | 21    | .10      | BL1234 | 0     | .00      |
| C1  | 97    | .46      | LB1    | 1     | .00      |
| C2  | 60    | .28      | LB2    | 6     | .02      |
| B1  | 170   | .40      | LB3    | 1     | .00      |
| SA1 | 14    | .03      | LB4    | 16    | .07      |
| SA2 | 14    | .03      | R26LC1 | 0     | .00      |
| SB  | 0     | .00      | LC2    | 0     | .00      |
| C3  | 65    | .30      | LC3    | 0     | .00      |
| C4  | 65    | .30      | LC4    | 16    | .07      |
| B2  | 95    | .45      | SLC    | 0     | .00      |
| G1  | 331   | 1.57     | SLD    | 0     | .00      |
| A   | 3     | .00      | CL1234 | 0     | .00      |
| B   | 0     | .00      | DL1234 | 0     | .00      |
| A   | 0     | .00      | LD1    | 0     | .00      |
| B   | 2     | .00      | LD2    | 0     | .00      |
| C   | 0     | .00      | LD3    | 0     | .00      |
|     | 42    | .01      | LD4    | 10    | .04      |
|     | 40    | .01      | R27    | 0     | .00      |
| A   | 0     | .00      | R28    | 0     | .00      |
| B   | 3     | .00      | R29 A  | 0     | .00      |
| A   | 0     | .00      | B      | 0     | .00      |
| B   | 0     | .00      | R30 D6 | 49    | .23      |
| A   | 0     | .00      | GT     | 1135  | 5.40     |
| B   | 1     | .00      | D5H    | 0     | .00      |
| A1  | 33    | .15      | D7     | 45    | .21      |
| A2  | 37    | .17      | D6H    | 0     | .00      |
| C1  | 128   | .60      | D7H    | 0     | .00      |
| C2  | 63    | .30      | D5     | 41    | .19      |
| B1  | 253   | .60      | D8     | 93    | .44      |
| SA1 | 19    | .04      | D1H    | 5     | .02      |
| SA2 | 15    | .03      | D4H    | 0     | .00      |
| SB  | 0     | .00      | D2     | 49    | .23      |
| C3  | 57    | .27      | D3     | 43    | .20      |
| C4  | 61    | .29      | D1     | 44    | .20      |
| B2  | 109   | .51      | D3H    | 0     | .00      |
| G1  | 340   | 1.61     | D2H    | 1     | .00      |
| R17 | 0     | .00      | D4     | 46    | .21      |

344 344 344 344 344 344 344

1 BASE @ OCTAL  
 2 : AG2H 17 160 1 MASKSET 10000 XF = 2 XCH = 0 YCH = 0 XOR =  
 3 0 YOR = 1 ZCH = ;  
 4 : AG2L 37 140 1 MASKSET 10000 XF = 2 XCH = 0 YCH =  
 5 0 XOR = 0 YOR = 1 ZCH = ;  
 6 : AG1H 117 60 1 MASKSET 10000 XF = 2 XCH = 0 YCH =  
 7 0 XOR = 0 YOR = 1 ZCH = ;  
 10 : AG1L 137 40 1 MASKSET 10000 XF = 2 XCH = 0 YCH =  
 11 0 XOR = 0 YOR = 1 ZCH = ;  
 12 : BG3H 4053 124 1 MASKSET 10000 XF = 0 XCH = 2 YCH =  
 13 0 XOR = 0 YOR = 1 ZCH = ;  
 14 : BG3L 4073 104 1 MASKSET 10000 XF = 0 XCH = 2 YCH =  
 15 0 XOR = 0 YOR = 1 ZCH = ;  
 16 : BG2H 4013 164 1 MASKSET 10000 XF = 0 XCH = 2 YCH =  
 17 0 XOR = 0 YOR = 1 ZCH = ;  
 20 345 LOAD BASE = ;S

XCH PHA  
 0 3  
 1 2  
 2 1

345 345 345 345 345 345 345 345

1 : BG2L 4033 144 1 MASKSET 10000 XF = 0 XCH = 2 YCH =  
 2 0 XOR = 0 YOR = 1 ZCH = ;  
 3 : BG1H 4113 64 1 MASKSET 10000 XF = 0 XCH = 2 YCH =  
 4 0 XOR = 0 YOR = 1 ZCH = ;  
 5 : BG1L 4133 44 1 MASKSET 10000 XF = 0 XCH = 2 YCH =  
 6 0 XOR = 0 YOR = 1 ZCH = ;  
 7 : AS1H 17 20 1 MASKSET 10000 XF = 2 XCH = 0 YCH =  
 10 0 XOR = 0 YOR = 1 ZCH = ;  
 11 : AS1L 37 0 1 MASKSET 10000 XF = 2 XCH = 0 YCH =  
 12 0 XOR = 0 YOR = 1 ZCH = ;  
 13 : BS1H 4013 24 1 MASKSET 10000 XF = 0 XCH = 2 YCH =  
 14 0 XOR = 0 YOR = 1 ZCH = ;  
 15 : BS1L 4033 4 1 MASKSET 10000 XF = 0 XCH = 2 YCH =  
 16 0 XOR = 0 YOR = 1 ZCH = ;  
 17 : AS2H 15 22 1 MASKSET 10000 XF = 2 XCH = 0 YCH =  
 20 0 XOR = 0 YOR = 1 ZCH = ; 346 LOAD ;S

346 346 346 346 346 346 346 346

1 : AS2L 35 2 1 MASKSET 10000 XF = 2 XCH = 0 YCH =  
 2 0 XOR = 0 YOR = 1 ZCH = ;  
 3 : BS2H 4011 26 1 MASKSET 10000 XF = 0 XCH = 2 YCH =  
 4 0 XOR = 0 YOR = 1 ZCH = ;  
 5 : BS2L 4031 6 1 MASKSET 10000 XF = 0 XCH = 2 YCH =  
 6 0 XOR = 0 YOR = 1 ZCH = ;  
 7 : P1H 13 4024 1 MASKSET 4000 XF = 2 XCH = 1 YCH =  
 10 0 XOR = 0 YOR = 0 ZCH = ;  
 11 : P1L 33 4004 1 MASKSET 4000 XF = 2 XCH = 1 YCH =  
 12 0 XOR = 0 YOR = 0 ZCH = ;  
 13 : P2H 11 4026 1 MASKSET 4000 XF = 2 XCH = 1 YCH =  
 14 0 XOR = 0 YOR = 0 ZCH = ;  
 15 : P2L 31 4006 1 MASKSET 4000 XF = 2 XCH = 1 YCH =  
 16 0 XOR = 0 YOR = 0 ZCH = ;  
 17 347 LOAD ;S  
 20 ;S

347 347 347 347 347 347 347 347 347  
1 : AG3H 57 120 1 MASKSET 10000 XF = 2 XCH = 0 YCH =  
2 0 XOR = 0 YOR = 1 ZCH = ;  
3 : AG3L 77 100 1 MASKSET 10000 XF = 2 XCH = 0 YCH =  
4 0 XOR = 0 YOR = 1 ZCH = ;  
5 : LA 407 10 1 MASKSET 10000 XF = 0 XCH = 2 YCH =  
6 0 XOR = 0 YOR = 1 ZCH = ;  
7 : LB 7 410 1 MASKSET 10000 XF = 0 XCH = 2 YCH =  
10 0 XOR = 0 YOR = 1 ZCH = ;  
11 : LC 405 12 1 MASKSET 10000 XF = 0 XCH = 2 YCH =  
12 0 XOR = 0 YOR = 1 ZCH = ;  
13 : LD 5 412 1 MASKSET 10000 XF = 0 XCH = 2 YCH =  
14 0 XOR = 0 YOR = 1 ZCH = ;  
15 : LAS 407 4010 1 MASKSET 10000 XF = 0 XCH = 2 YCH =  
16 0 XOR = 0 YOR = 1 ZCH = ;  
17 350 LOAD :S  
20 :S

350 350 350 350 350 350 350 350 350  
1 : LBS 7 4410 1 MASKSET 10000 XF = 0 XCH = 2 YCH =  
2 0 XOR = 0 YOR = 1 ZCH = ;  
3 : LCS 405 4012 1 MASKSET 10000 XF = 0 XCH = 2 YCH =  
4 0 XOR = 0 YOR = 1 ZCH = ;  
5 : LDS 5 4412 1 MASKSET 10000 XF = 0 XCH = 2 YCH =  
6 0 XOR = 0 YOR = 1 ZCH = ;  
7 :S  
10  
11  
12  
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16  
17  
20

351 351 351 351 351 351 351 351 351  
1 :S  
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20

Primary beam energy measured using magnet current at  
2000 cm. rail position

$$\text{Energy} = \overset{495}{\cancel{482}} \pm 5 \text{ MeV/N}$$

## TARGET WHEEL

Position # 1 contains 4" poly target

didn't really use this  
— used poly target in front  
of telescope in order to get  
enough fragments

# New MASKS

| <u>ON</u> | <u>OFF</u> |                                     |
|-----------|------------|-------------------------------------|
| 106       | 4031       | BS, HET 2, $\overline{G2}$ required |
| 6         | 4171       | BS, HET 2, G3 required              |
| 106       | 4071       | BS, HET 2, $\overline{G1}$ required |
| 104       | 4033       | BS, HET 1, $\overline{G2}$ required |
| 104       | 4073       | BS, HET 1, $\overline{G1}$ required |

| Run No. | Start - Stop Times     | Nominal Beam Energy / Particle | CU (cm)                 | CH <sub>2</sub> (cm) | Telescope | Config. (A or B) end | Gain Mode | Tape No. | File No. | Count Rate of 1st Detector |
|---------|------------------------|--------------------------------|-------------------------|----------------------|-----------|----------------------|-----------|----------|----------|----------------------------|
| 1       | 2/18/77<br>1839 - 1741 | ~ 500                          | 0                       | 0                    | HET 2     | B                    | Lo        | 77BK02   | 1        | 300-60                     |
| 2       | 1552 - 1905            | ~ 300                          | 1.187                   | 0                    | "         | "                    | "         | "        | 2        | ~160                       |
| 3       | 1720 - 1935            | ~ 200                          | 1.700                   | 0                    | "         | "                    | "         | "        | 3        | 20-10.                     |
| 4       | 2002 - 2019            | ~ 150                          | 1.906                   | 0                    | "         | "                    | "         | "        | 4        | ~200                       |
| 5       | 2115 - 2125            | ~ 100                          | 1.9938                  | 0                    | "         | "                    | "         | 77BK03   | 1        | ~100                       |
| 6       | 2155 - 2225            | smear                          | 1.1443<br>+ wedge       | 0                    | "         | "                    | "         | 77BK04   | 1        | ~ 200                      |
| 7       | 2240 - 2104            | "                              | "                       | "                    | "         | "                    | "         | "        | 2        | ~100                       |
| 8       | 2330 - 0022<br>2/19/77 | Fragments                      | .6109<br>+ wedge        | 9.1                  | "         | "                    | "         | 77BK05   | 1        | ~200                       |
| 9       | 0105 - 0200            | "                              | .8014<br>1.1075         | 3 1/2"               | "         | "                    | "         | 06       | 1        | ~200                       |
| 10      | 445 - 520              | "                              | .7031<br>.7055<br>.7078 | "                    | LETB      | LETB                 |           | 07       | 1        | ~150                       |
| 11      | 527 - 540              | "                              | .7031<br>7107           | "                    | LETA      | LETA                 |           | 07       | 2        | ?                          |
| 12      | 554 - 622              | "                              | .7107<br>7031           | "                    | LETC      | LETC                 |           | 77BK06   | 1        | ?                          |
| 13      | 625 - 650              | "                              | .7031<br>7107           | "                    | LETD      | LETD                 |           | "        | 2        | ?                          |
| 14      | 701 - 705              | "                              | "                       | "                    | "         | "                    |           | "        | 3        | ?                          |
| 15      | 714 - 718              | "                              | .7214                   | "                    | "         | "                    |           | 09       | 1        | ?                          |
| 16      | 717 - 728              | "                              | "                       | "                    | "         | "                    |           | 09       | 2        | ?                          |

(CTS/PULS)

# Comments

beam interrupted by HILAC

smearred energy due to Cu wedge in front of telescope. Thin edge of wedge at edge of detector, just outside box.

"

poly + wedge both - poly target wheel

poly = 3 1/2" in target room  
changed Cu to 1.1075 or  $\approx 1:15$

good L1 vs L3 plot  
sent delete L3 term command  
add 24  $\mu$ , add 23  $\mu$ , back to .7031  
start with L3 term deleted  
add 76  $\mu$

start with L3 term deleted  
remove 76  $\mu$   
L3 term deleted, add 76  $\mu$

L4 pure off, 7031, 7107 Cu as on previous runs  
L4 off, .7214 removes most Ar  
L4 on " " .7265 better



# Comments

L4 on , low rate , pen Ar , L4 works

L4 on , high rate , pen Ar , L4 doesn't work

pen Ar in HET2

Changed absorber to 13705 after ~10 min.

$\phi \sim 10-15^\circ$

back to  $\phi = 0$

fragments

suppress HIP events , less Cu

now in A config

add Cu to 1.8403 , ~~1.5355~~ , then 1.6866 , then 1.7260

see below

scan all over thickness range trying for AIAZ!  
before realizing wedge filters them out.

Now use LET settings & poly - works.

Suppress analysis of penetrating particles, allow G

some AIAZ noise, suppress pen, allow G

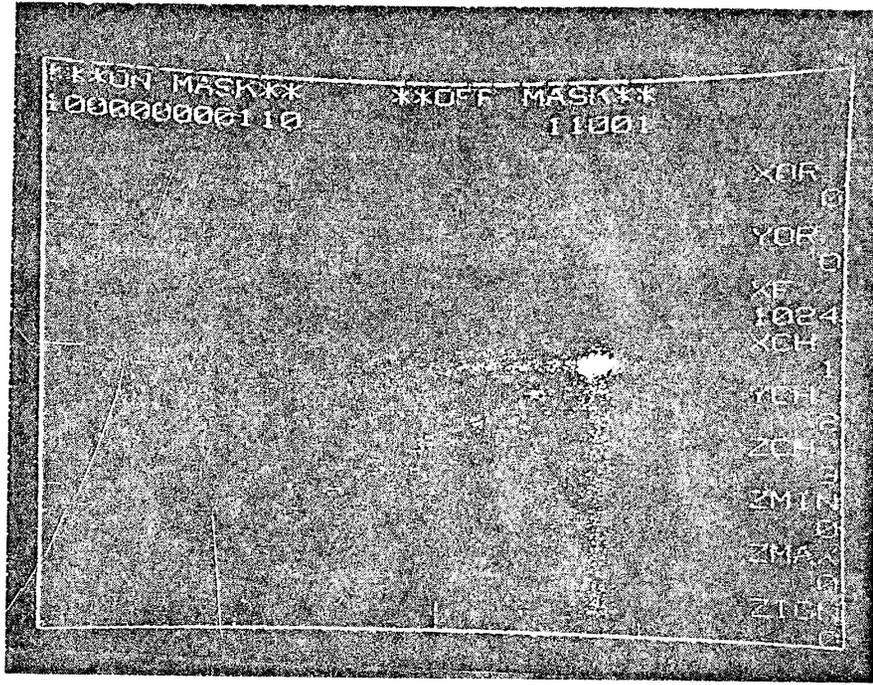
remove monitor no alert

| Run | Time        | Nominal Energy | Cu              | CH <sub>2</sub> | Telescope | Config. | Gain | Tape No. | File No. | Co |
|-----|-------------|----------------|-----------------|-----------------|-----------|---------|------|----------|----------|----|
| 35  | 1618 - 1630 | Fragment       | .7107           | 3 1/2"          | HETZ      | A       | LO   | 14       | 3        |    |
| 36  | 1715        | "              | <del>7107</del> | 3 1/2"          | HETZ      | A       | LO   | 14       | 4        |    |
| 37  | 1718 - 1733 | "              | .7031           | "               | "         | "       | "    | "        | 5        |    |
| 38  | 1736 - 1800 | "              | "               | "               | "         | "       | HI   | 15       | 1        |    |
| 39  | 1803        | "              | "               | "               | "         | "       | AUTO | 15       | 2        |    |

Run 1

~~B1 vs C1~~  
Lo Gain

C1



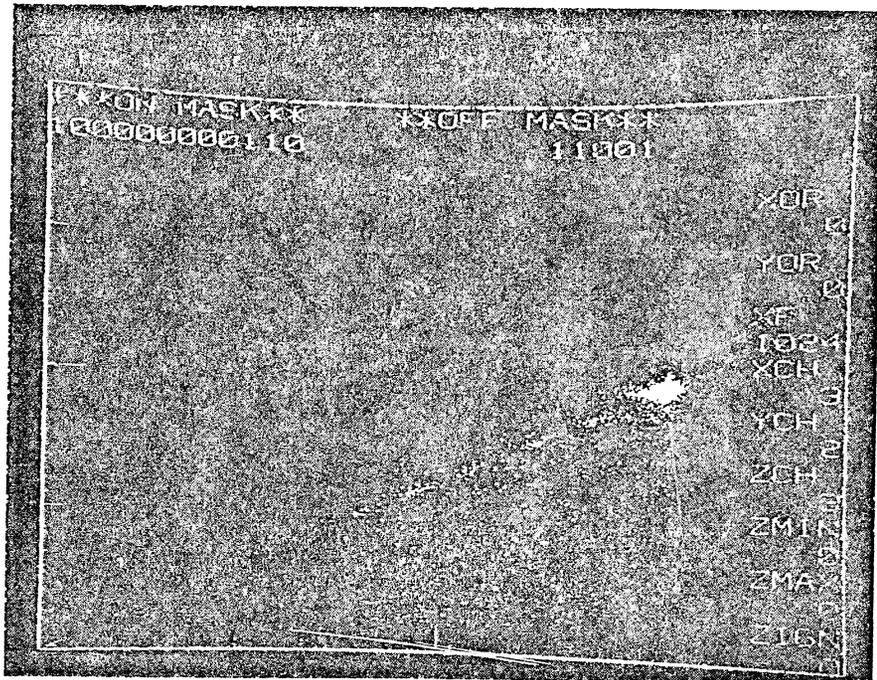
B1

Run 1

~~B1 vs  $\frac{4}{2} C1$~~

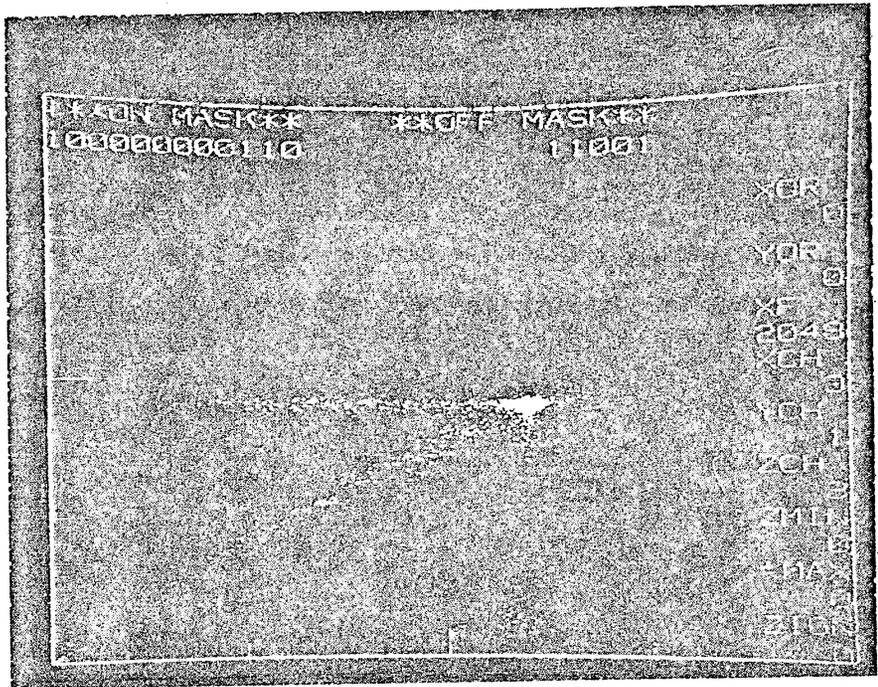
Lo Gain

C1



$\frac{4}{2} C$

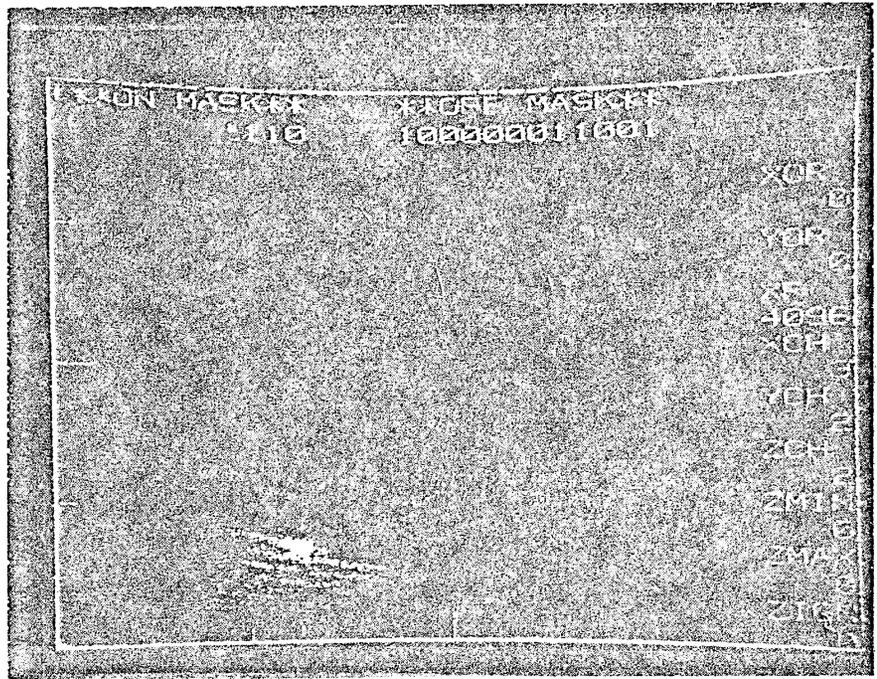
31



$\sum_{2}^{4} C$

Page 3

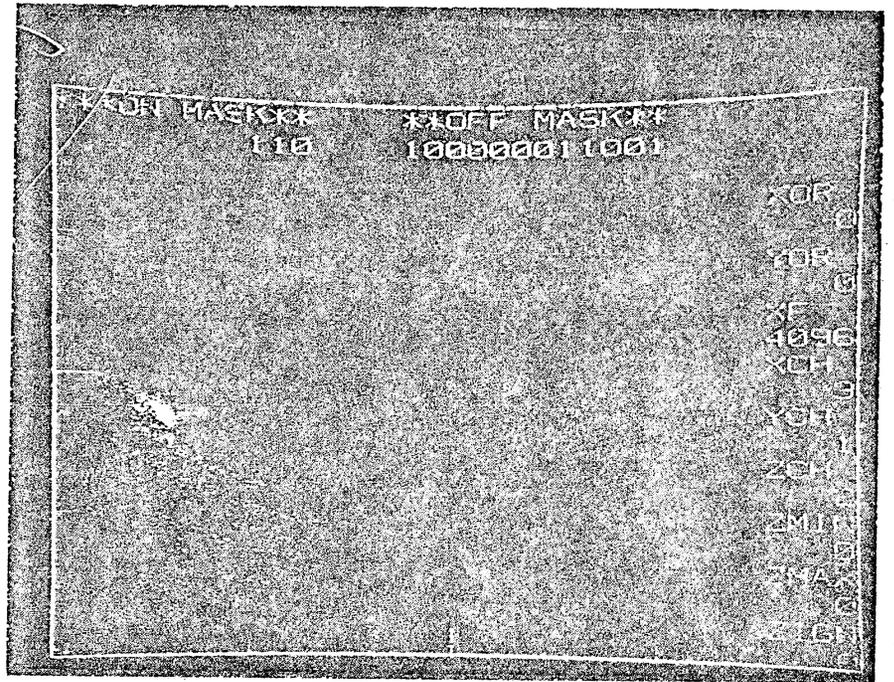
B2  
~~XXXX~~



$\sum_{2}^{4} C$

Run 4

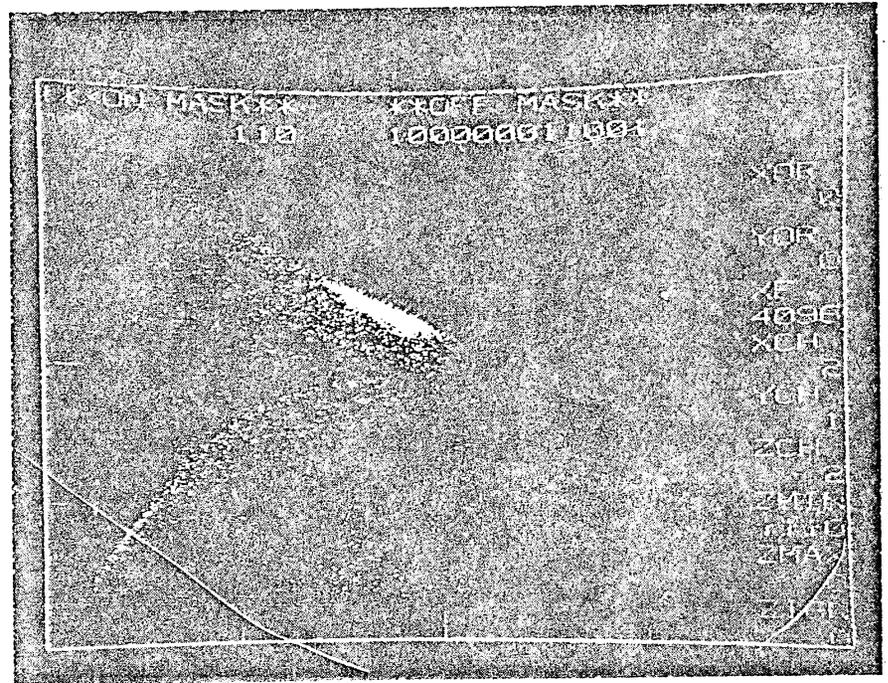
B1



$\sum_{i=2}^4$

Run 5

B1



B2

Run 6

Run 6

B1

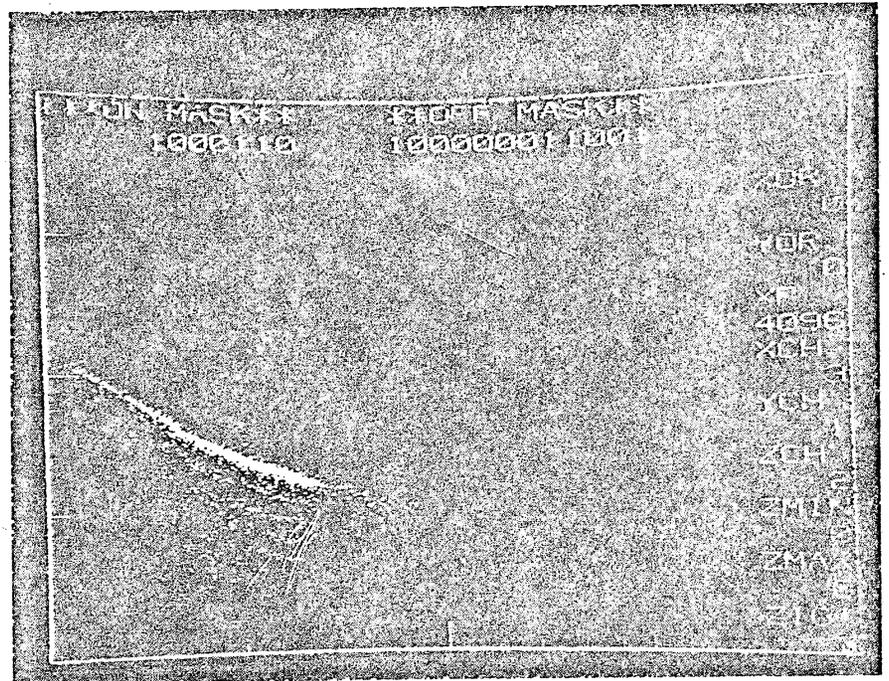


ΣC

Run 6

is required

B1

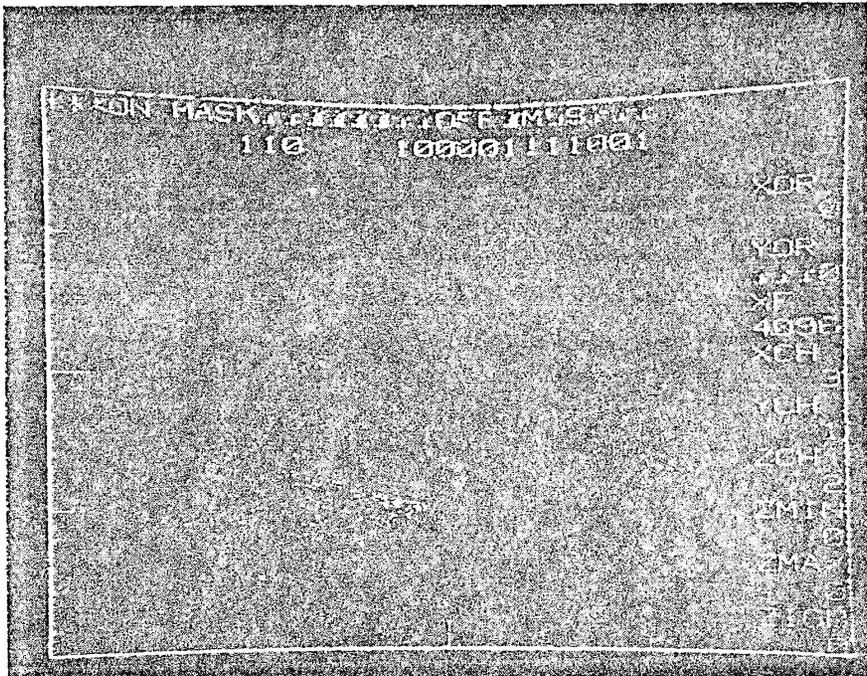


ΣC

Run 7

G terms deleted  
G3 required in  
plot mask

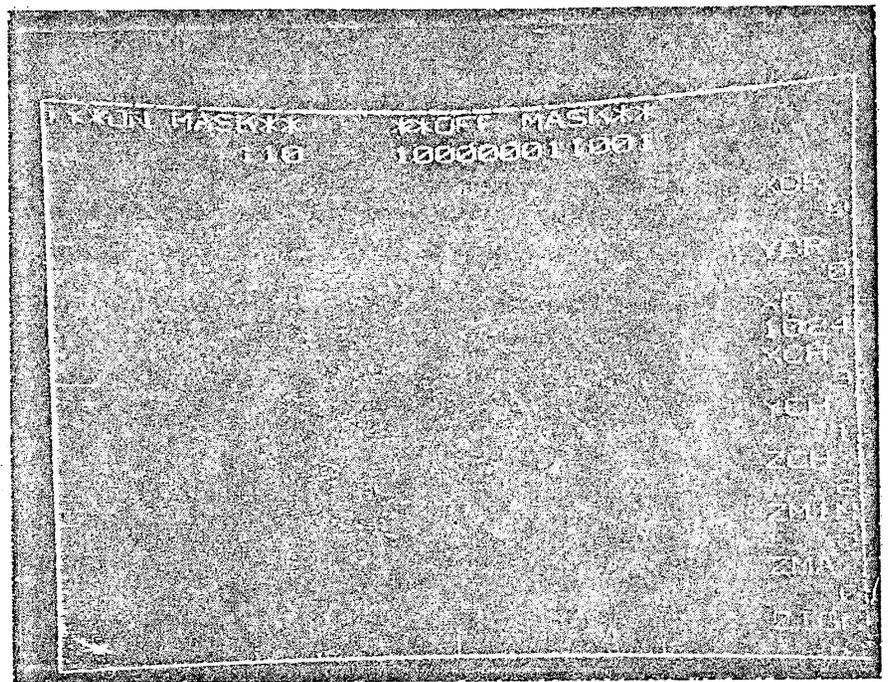
B1



4  
2  
C  
2

Row 8

B1

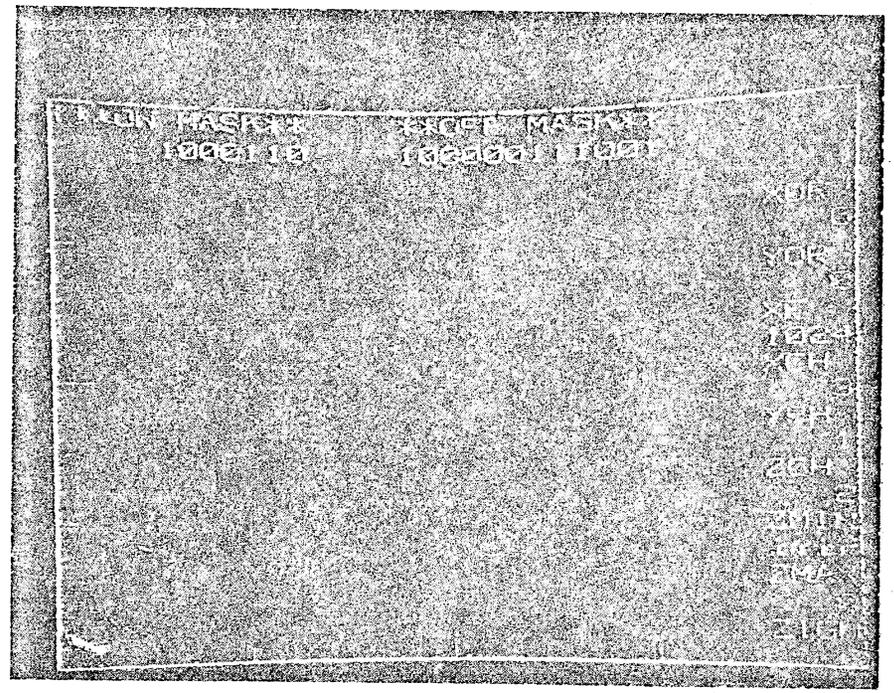


$\frac{4}{2} C$

Row 8

B1

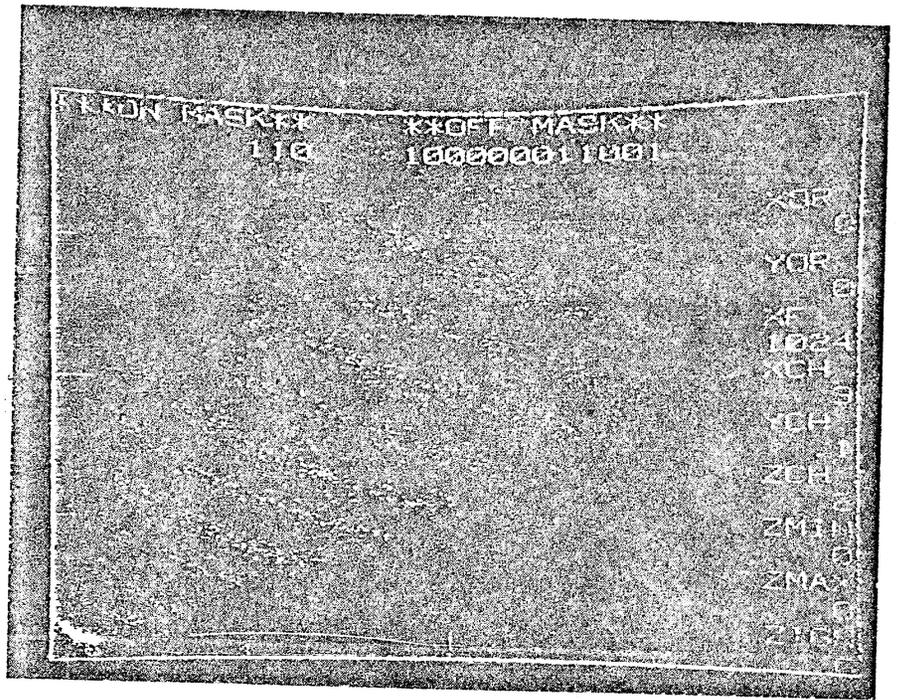
G1 required



$\frac{4}{2} C$

Run 9

B1

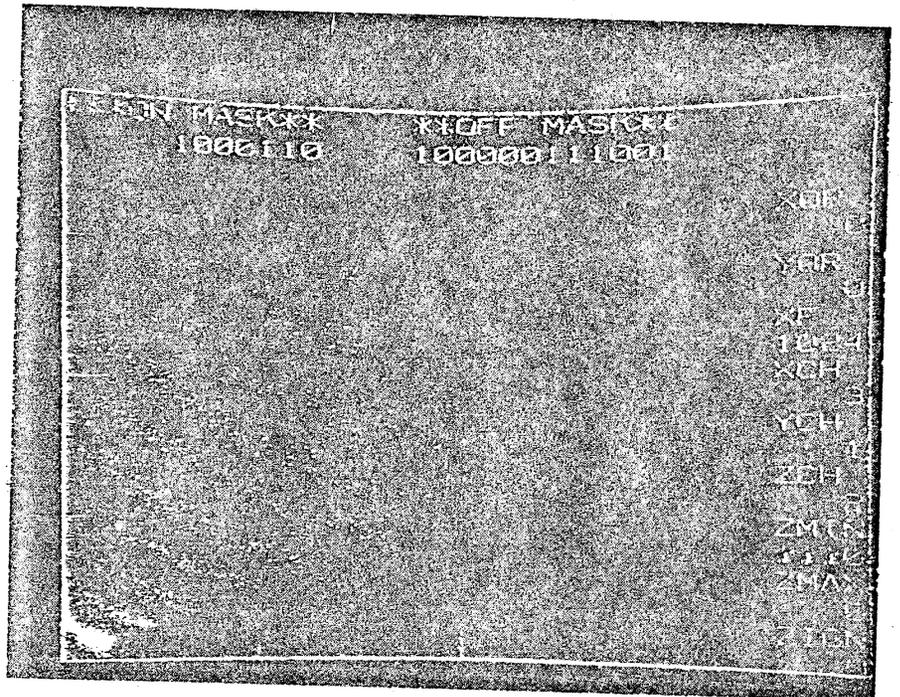


$\frac{4}{2}C$

Run 9

$\overline{G1}$  required

B1

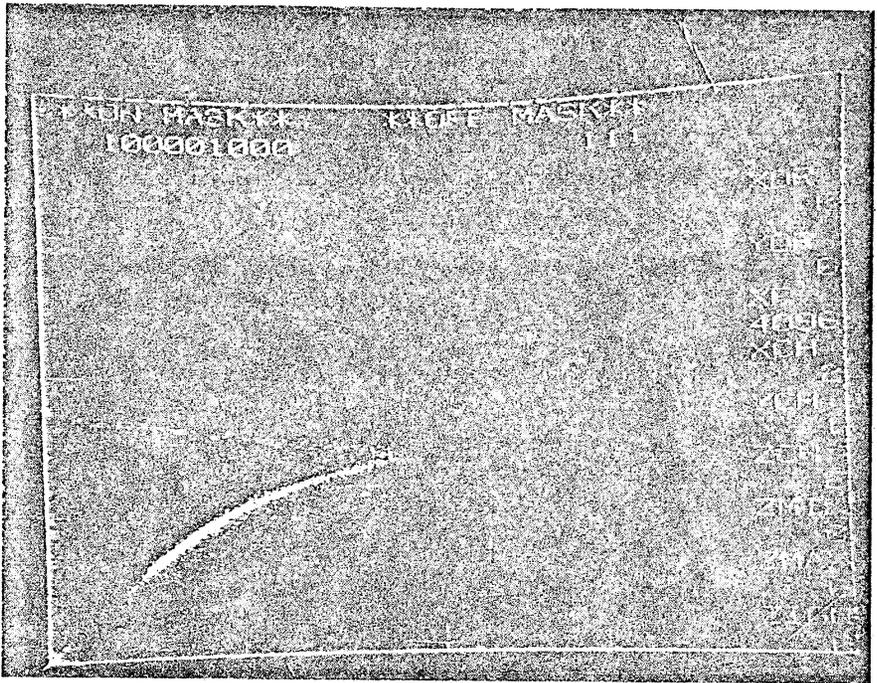


$\frac{4}{2}C$

no 10

LETB

L1

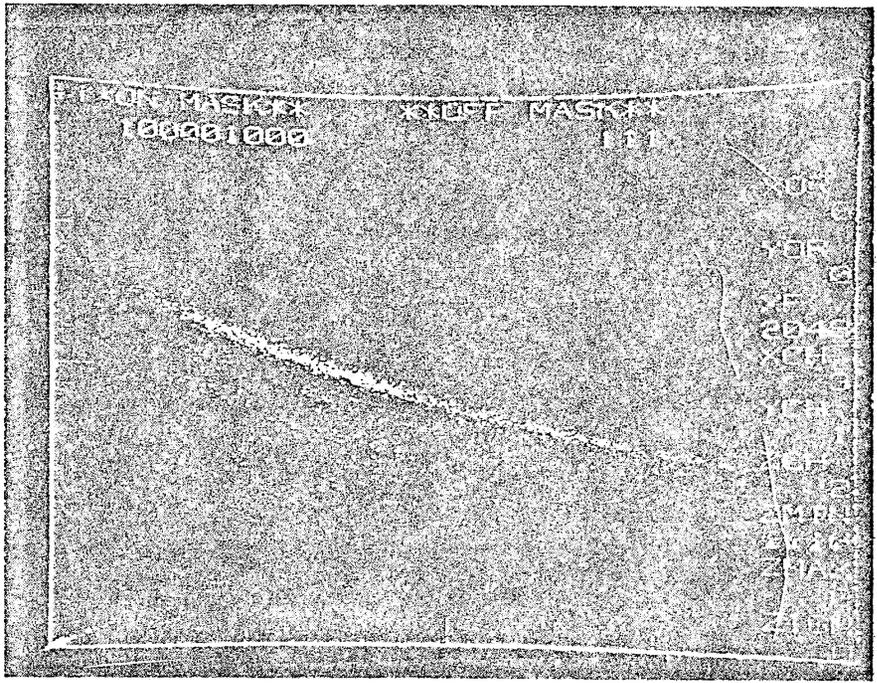


L2

no 10

LETB

L1

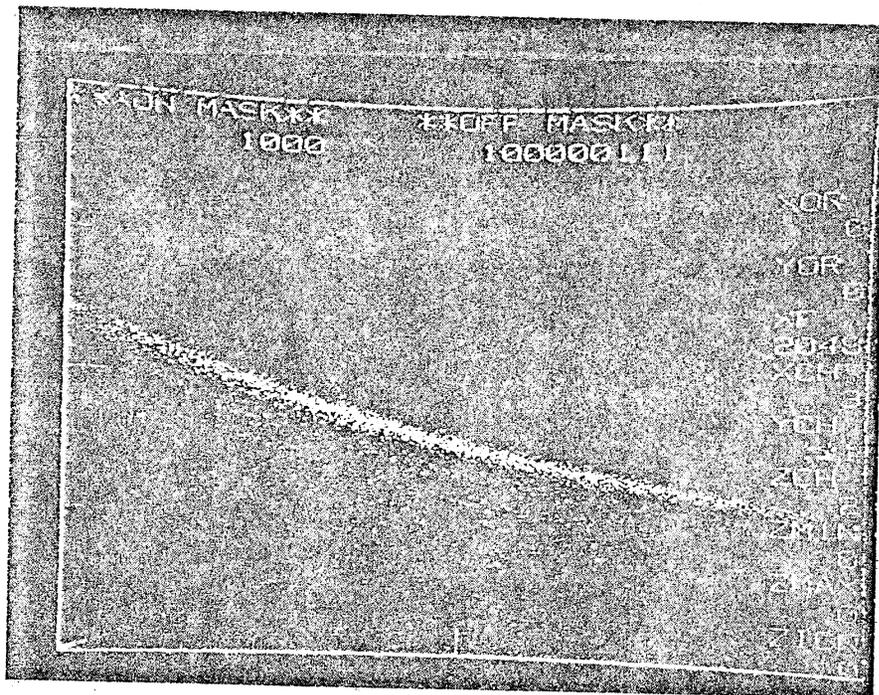


L3

Run 11

LETA

L1

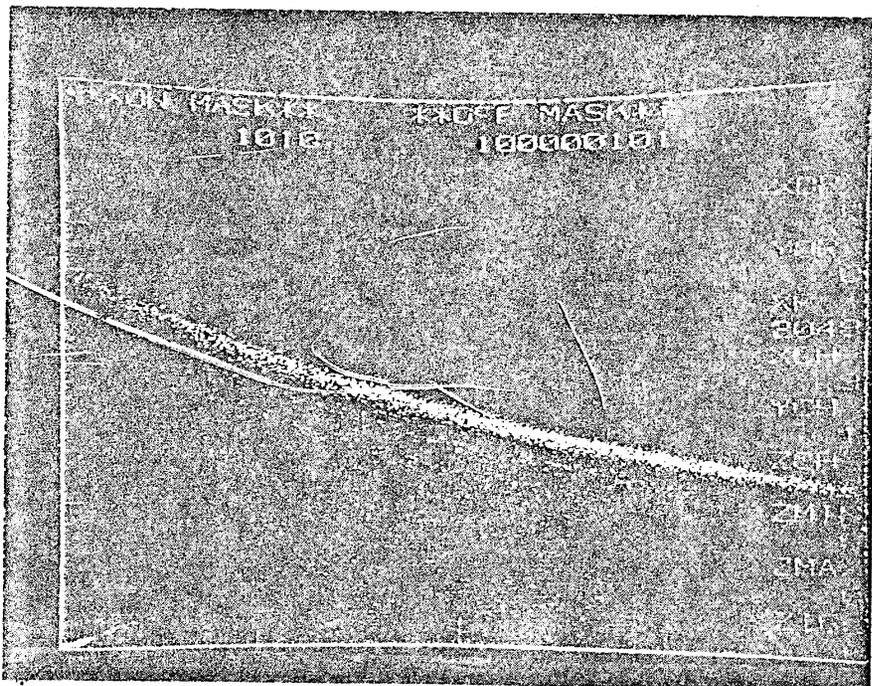


L3

Run 12

LET C

L1

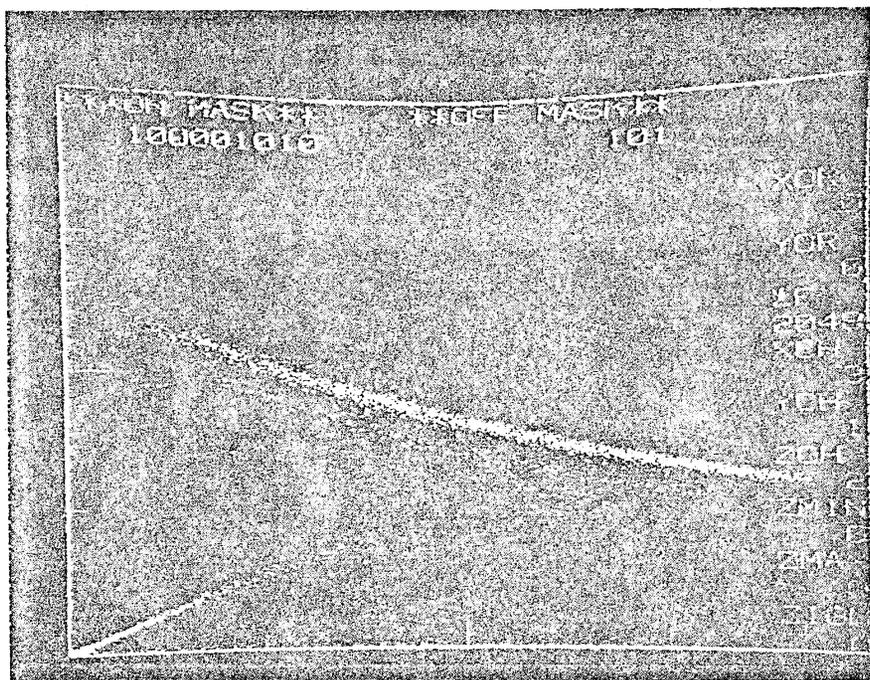


L3

13  
ETD

L1

lots of protruding particles.



L3

un 20

HET 1

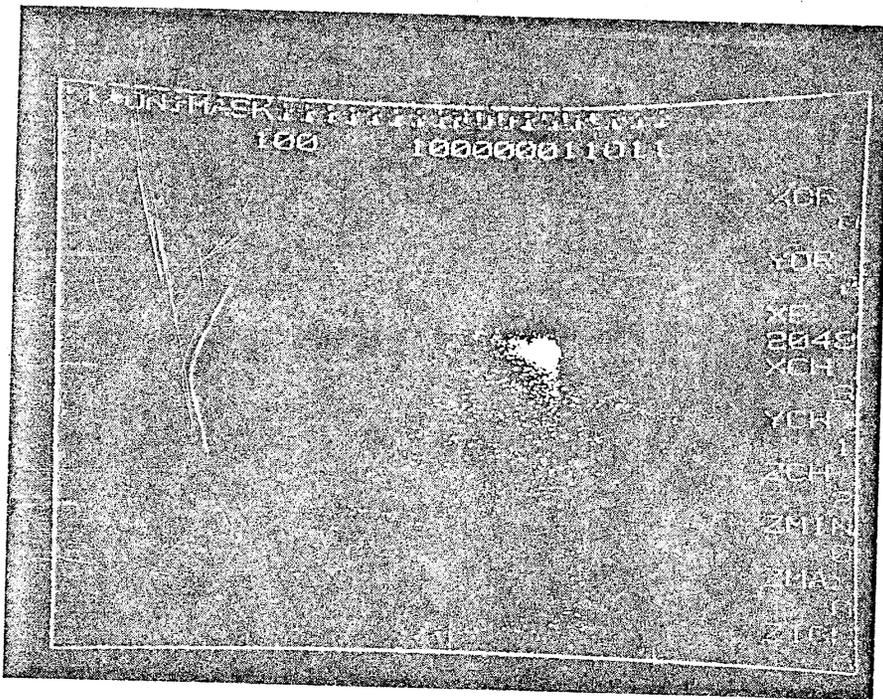
End

CI  
~~CI~~



81  
2

B1

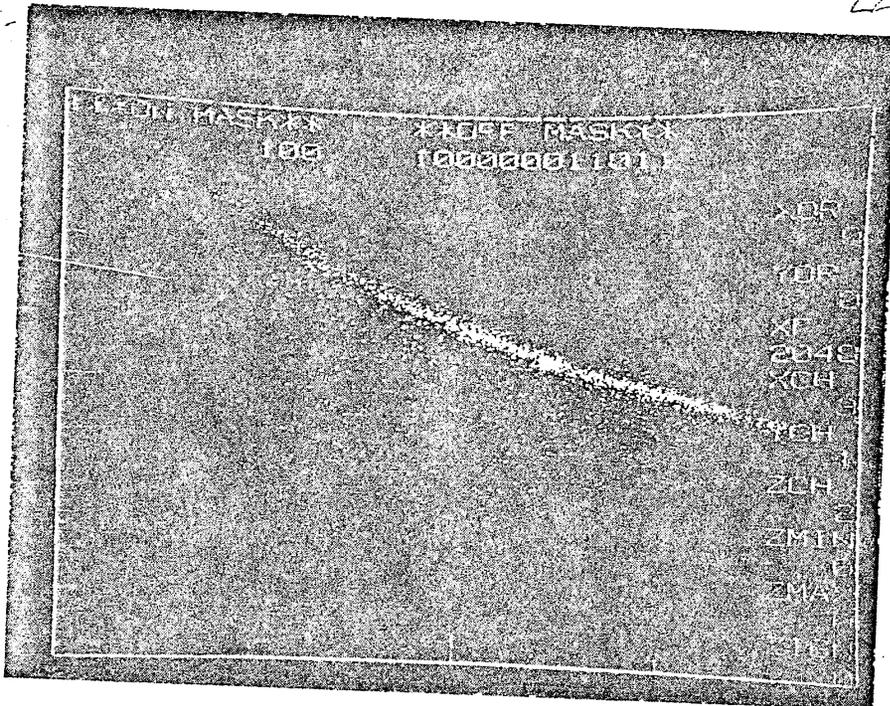


Run 21

$\Sigma C$

22

B1



Run 22

STW 1/1/60

$\frac{4}{\Sigma C}$   
2

Run 22

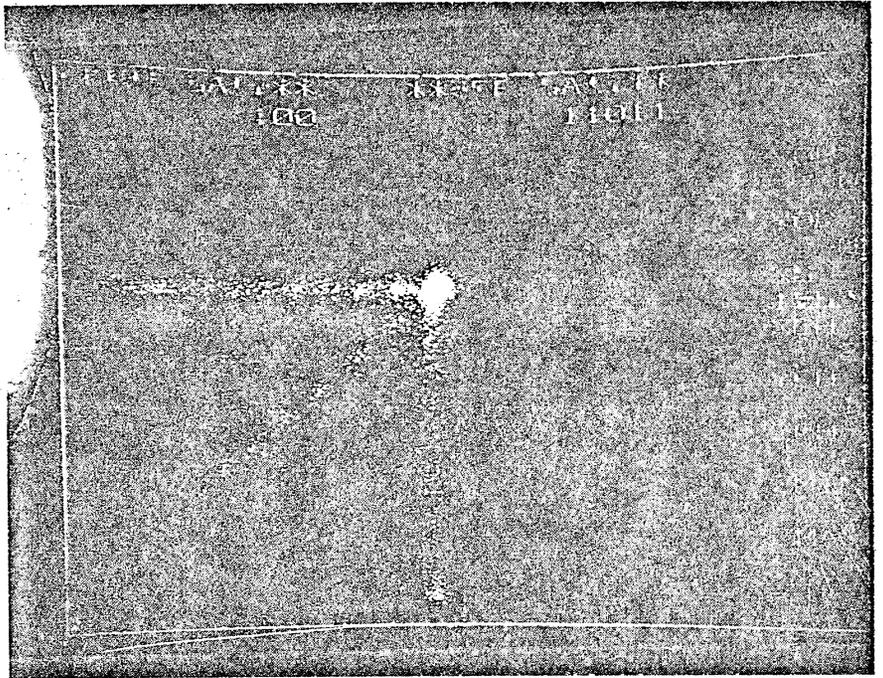
$\overline{G_2}$  required

$$\frac{4}{2C}$$

23

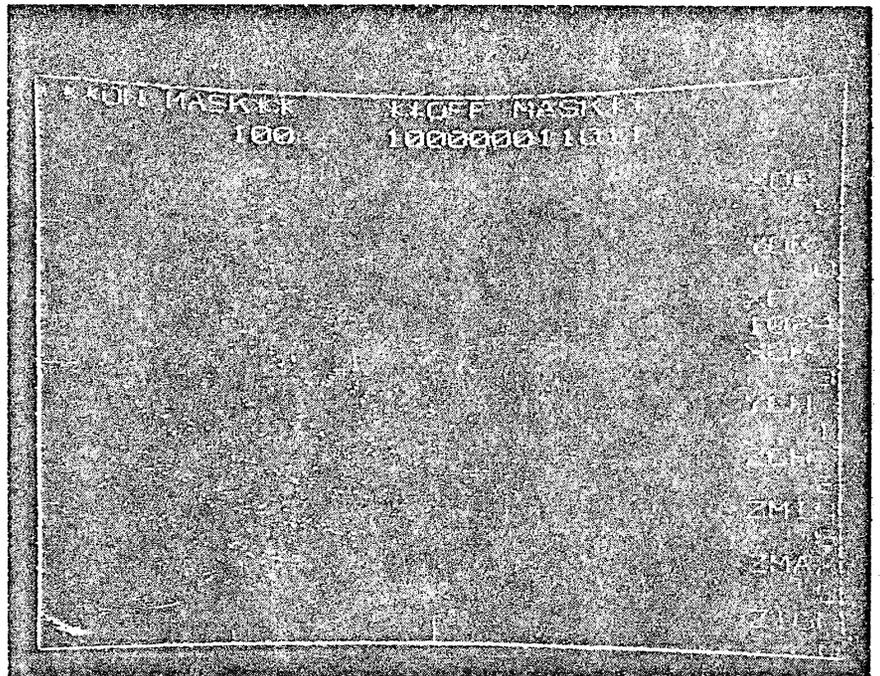
Run 23

Run 24



Run 26

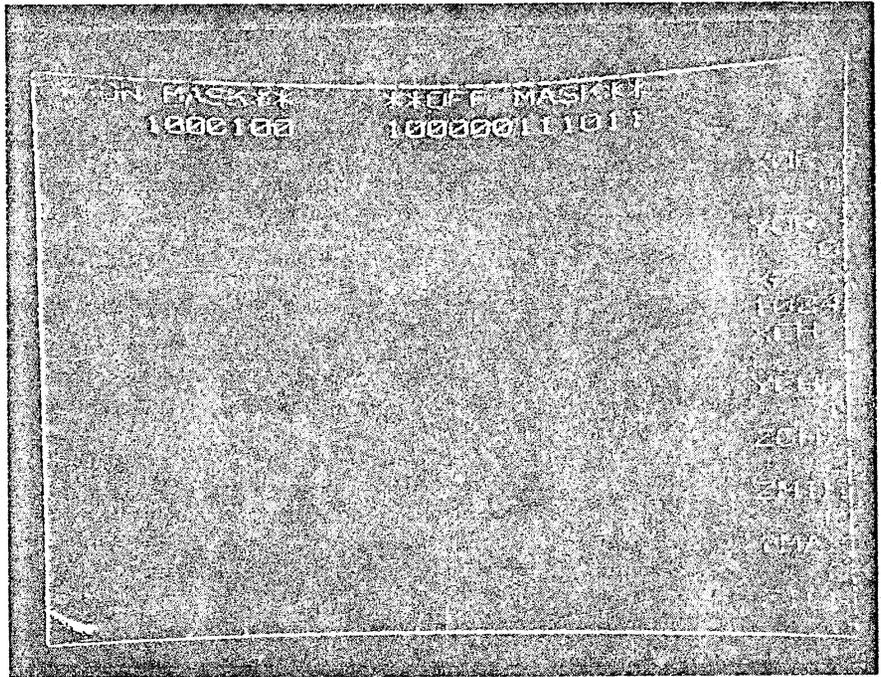
B1



$\Sigma C$   
2

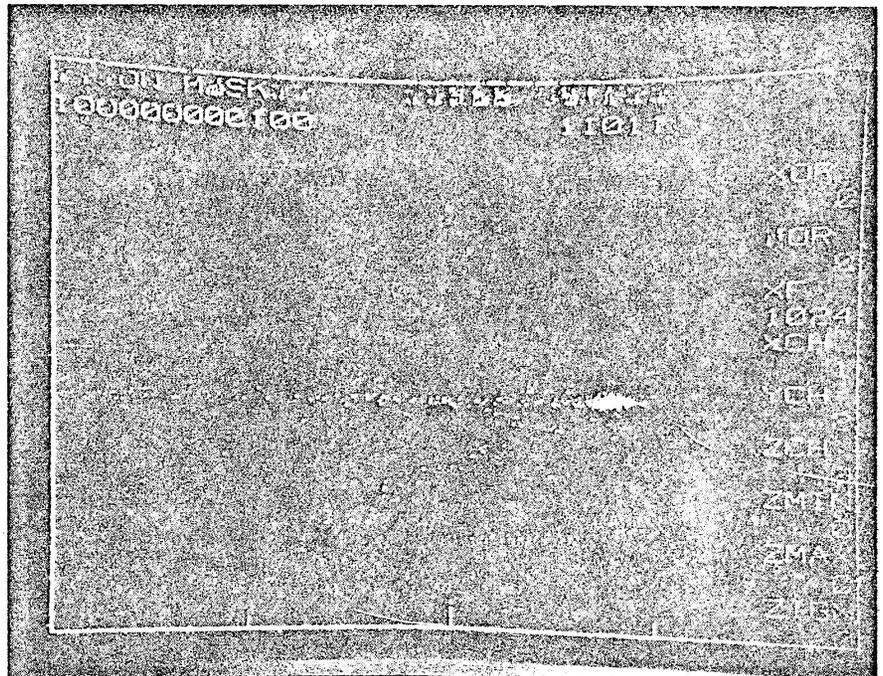
24

B1



Σ C

27



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314.7-278

23 February 1979

TO: N. N. Toy

FROM: S. L. Hast SLH

SUBJECT: Coordinate Systems Used in the Voyager Navigation System Programs

### I. Coordinate Frames and Frame Reference Epochs

The Voyager navigation software system, composed of the Orbit Determination Program (ODP) and the Double Precision Trajectory Program (DPTRAJ), expresses the spacecraft and celestial body states in various coordinate systems. A coordinate frame is defined in terms of an associated set of Cartesian axes (x,y,z). The x-y plane is a defined reference plane. The reference plane can be specified as the equatorial plane, the orbit plane, the plane of sky (the plane perpendicular to the line of sight of the observer), or the magnetic equator (magnetic dipole model for Jupiter, Saturn and Uranus). The x-axis is a reference direction. The reference direction can be specified as the vernal equinox or the prime meridian (or magnetic dipole prime meridian for the magnetic equator). The z-axis is normal to the reference plane in a direction corresponding to some physical quantity. Coordinate frames are defined in terms of a time at which they physically exist or, a frame reference epoch. This time may be input as zero, meaning "of date", or '1950' meaning 1950.0 ET, the beginning of the Besselian year 1950 (this corresponds to a calendar date of Dec. 31, 1949 22:09:38.076827794 ET or a Julian ephemeris date of 2433282.423357370692). The center of the frame may be at the center of any of nine planets, Sun or Moon, thirty-three natural satellites, or a defined station on the surface of any of these bodies. For planetary systems which include natural satellites, the center may be specified as either the planet center or the planet-satellite system barycenter. Table I summarizes the coordinate systems used in DPTRAJ and ODP.

### II. EME50 - The Fundamental Navigation Coordinate System

The fundamental coordinate system used internally by DPTRAJ and ODP is the Cartesian frame formed by the Earth mean equator and equinox of 1950.0; the position of the mean equator of the Earth and the ascending node of the mean orbit of the Earth on that equator, taken at the beginning of the Besselian year 1950 (Ref. 7), serve as the definition. The x-axis is directed along the ascending node, the z-axis northward, normal to the equator, and the y-axis in a direction to complete the usual right-handed coordinate system.

TABLE 1. DPTRAJ COORDINATE SYSTEMS

| COORDINATE SYSTEM<br>Name       | DPTRAJ INPUTS |           |                       |           | X-Y Plane   | X-Axis  | Z-Axis   |
|---------------------------------|---------------|-----------|-----------------------|-----------|---|---|--|
|                                 | X-Axis        | Z-Axis(1) | Z-Axis(2)             | Z-Axis(3) |   |   |  |
| Mean Equator and Equinox        | 6HSPACEB      | 6H(body1) | 6HFACEBB              | 6HEQUATO  | Mean Equator of Body  | Ascending node of mean orbit on mean equator (mean equinox) | Z-Axis<br>Direction of body<br>Rotation vector (earth)<br>Rotation of Orbital<br>Rotation Vector |
| Mean Orbit and Equinox          | 6HSPACEB      | 6H(body1) | 6HFACEBB              | 6HORBITA  | Mean orbit of body  | Mean Equinox  | North  |
| True Equator and Equinox        | 6HSPACEB      | 6H(body1) | 6HTRUEBB              | 6HEQUATO  | True Equator of Body  | Ascending node of mean orbit on true equator (true equinox) | North  |
| Mean Orbit and True Equinox     | 6HSPACEB      | 6H(body1) | 6HTRUEBB              | 6HORBITA  | Mean orbit of body  | True Equinox  | Direction of Orbital<br>Rotation Vector  |
| Body Fixed                      | 6H(body1)     | 6H(body1) | 6HTRUEBB              | 6HEQUATO  | True Equator of Body  | Prime Meridian  | North  |
| Hour Angle/declination          | 6H(body1)     | 6H(body1) | 6HTRUEBB              | 6HEQUATO  | True Equator of Body  | Station Meridian  | North  |
| Horizon (Azimuth)/<br>Elevation | 6H(body1)     | 6H(body1) | 6HTRUEBB              | 6HORQUATO | Plane Perpendicular<br>to Vertical thru a<br>defined Station        | South   | Vertical   |
| Plane of the Sky                | 6HSPACEB      | 6H(body1) | 0 or sta-<br>tion no. | 6HPLSKY   | Plane Perpendicular<br>to vector from Frame<br>Center to "Observer" | Projection of 1950.0 Earth<br>North Vector on X-Y Plane     | Direction of Vector<br>from Frame Center to<br>"observer"  |
| Magnetic                        | 6H(body1)     | 6H(body1) | 6HTRUEBB              | 6HMAGCEQU | True magnetic equator<br>of body                                    | Magnetic Meridian   | Direction of magnetic<br>dipole moment vector  |

NOTES

There is no defined name associated with the true osculating orbit.

The adjective "true" or "mean" applied to equinox refers to the equator. Both use the mean orbit.

The prime meridian is an arbitrary meridian on the surface of the body designated as zero longitude.

Plane of the sky frame requires definition of "observer" e.g., Earth, or a station on Earth.

The center of the plane of sky frame is the center of body being observed.

\*\*May be 0.000 (of date) or 1950.000

The following data must be specified for the given frame:  
 Hour Angle/declination      Measurement System = 6HHA-DEC  
 Horizon (AZ/EL)              Measurement System = 6HAZ-EL

III. Space-Fixed and Body-Fixed Systems

The various coordinate systems may be classified as either "space-fixed" or "body-fixed." "Space-fixed" implies that the coordinate axes are "frozen" at the frame reference epoch and thus do not rotate with the body. (The exception to this is a "space-fixed of date" system where the velocity components include the motions of both the celestial body pole and the celestial body orbit plane pole. Thus, this system is not strictly inertial.) "Body-fixed" implies that the coordinate axes rotate with the body.

IV. Transformations Between Coordinate Systems

Frame transformations are performed only on Cartesian coordinates. These transformations are developed in terms of rotations about the current x, y, or z-axis. The rotation matrices are denoted symbolically as follows:

$$\{\theta\}_z = \begin{bmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}, \quad \{\theta\}_y = \begin{bmatrix} \cos\theta & 0 & -\sin\theta \\ 0 & 1 & 0 \\ \sin\theta & 0 & \cos\theta \end{bmatrix}, \quad \{\theta\}_x = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & \sin\theta \\ 0 & -\sin\theta & \cos\theta \end{bmatrix}$$

Figure 1 shows schematically the transformations between coordinate frames.

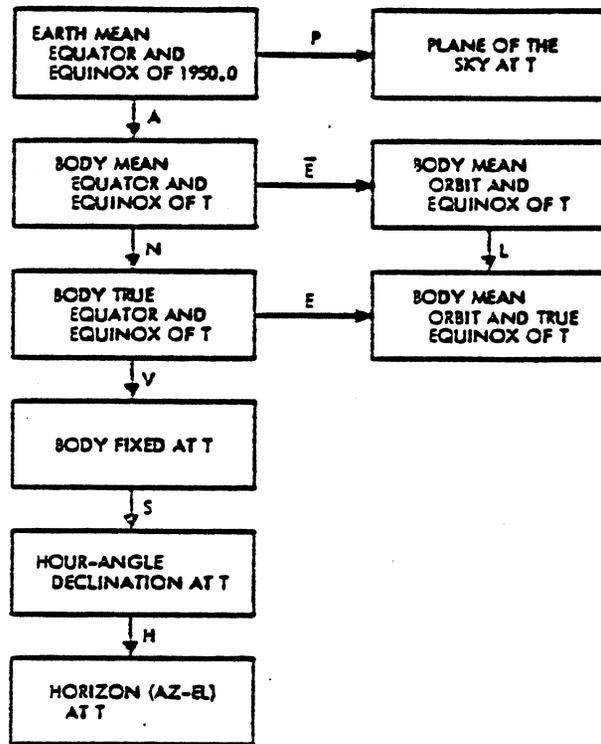


Figure 1. Transformations Between Frames

The general matrix definitions are as follows:

$$A = \left\{ \Delta_{50}^{(i)} + 180^\circ \right\}_Z \left\{ 90^\circ - \delta_{50}^{(i)} \right\}_X \left\{ \alpha_{50}^{(i)} + 90^\circ \right\}_Z$$

$$N = E^T L \bar{E} = \left\{ -\bar{\epsilon}^{(i)} - \delta \bar{\epsilon}^{(i)} \right\}_X \left\{ -\delta \psi^{(i)} \right\}_Z \left\{ \bar{\epsilon}^{(i)} \right\}_X$$

$$\bar{E} = \left\{ \bar{\epsilon}^{(i)} \right\}_X$$

$$L = \left\{ -\delta \psi^{(i)} \right\}_Z$$

$$E = \left\{ \bar{\epsilon}^{(i)} + \delta \epsilon^{(i)} \right\}_X$$

$$V = \left\{ v^{(i)} \right\}_Z$$

$$S = \left\{ \lambda_s \right\}_Z$$

$$H = \left\{ 90^\circ - \phi_s \right\}_Y$$

$$P = \left\{ \delta_o - 90^\circ \right\}_Y \left\{ \alpha_o - 180^\circ \right\}_Z$$

where

$\alpha_{50}^{(i)}$  = right ascension of body  $i$  mean North pole in mean 1950.0 frame.

$\delta_{50}^{(i)}$  = declination of body  $i$  mean North pole in mean 1950.0 frame.

$\Delta_{50}^{(i)}$  = arc from ascending node of body  $i$  mean equator on Earth 1950.0 mean equator, along body  $i$  equator to ascending node on body  $i$  mean orbit. (This is the mean autumnal equinox of body  $i$ .)

$\bar{\epsilon}^{(i)}$  = mean obliquity of body  $i$  (angle between mean orbit and mean equator).

$\delta\epsilon^{(i)}$  = nutation in obliquity.

$\delta\psi^{(i)}$  = nutation in longitude.

$V^{(i)}$  = angle from true equinox to prime meridian (hour angle of true equinox; right ascension of prime meridian).

$$= \bar{V}^{(i)} + \delta\psi^{(i)} \cos(\bar{\epsilon}^{(i)} + \delta\epsilon^{(i)})$$

$\lambda_s$  = East longitude of station.

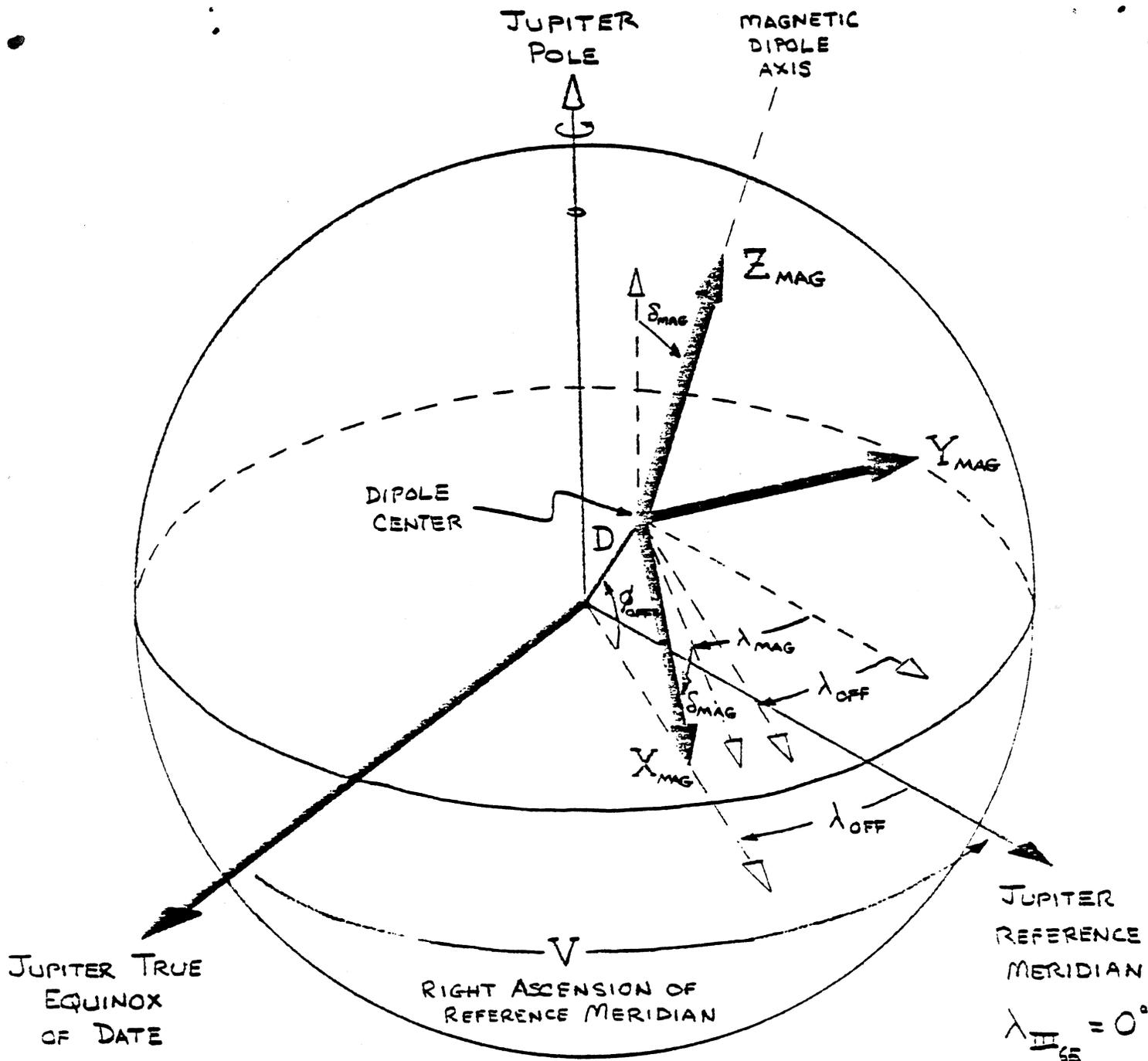
$\phi_s$  = geodetic latitude of station.

$\alpha_o$  = right ascension of observer in mean 1950.0 frame centered at same center as plane of sky frame.

$\delta_o$  = declination of observer (same frame as  $\alpha_o$ ).

#### V. Magnetic Coordinate System

DPTRAJ has the capability of modelling the magnetic fields of Jupiter, Saturn, and Uranus. At present, a model has been specified only for Jupiter. This "D4" model was developed by E. J. Smith (Reference 8) and the details of implementation were specified by F. M. Sturms (Reference 12). The model represents a tilted dipole, offset from the center of Jupiter. It is defined in Jupiter's System III (1965) rotating coordinates, as presented in Table II (A. B. Sergeevsky, Reference 10) and Figure 2. The zero magnetic meridian lies in the plane formed by the magnetic dipole axis and a vector centered at the magnetic dipole center and parallel to the planet's rotation vector; this can be seen in Figure 2.



$\lambda_{OFF}$  = REFERENCE LONGITUDE OF DIPOLE OFFSET (DEG, POSITIVE WEST)

$\phi_{OFF}$  = DIPOLE OFFSET LATITUDE (DEG)

D = DIPOLE OFFSET (KM)

$\lambda_{MAG}$  = DIPOLE LONGITUDE (DEG, POSITIVE WEST)

$\delta_{MAG}$  = DIPOLE AXIS COLATITUDE (DEG)

FIG. 2 JUPITER MAGNETIC COORDINATE  
SYSTEM

TABLE II \*\*\*  
REPRESENTATION OF THE ZEO MAGNETIC  
E. J. SMITH DIPOLE MODEL D4 IN SYSTEM III (1965)  
COORDINATES (\*)

A. DIPOLE TILT

|                 |       |                                   |
|-----------------|-------|-----------------------------------|
| Tilt Colatitude | 10.77 | (Deg)                             |
| Longitude, W    | 200.8 | (Deg)                             |
| Magn. Moment    | 4.225 | (Gauss · J.R. <sup>3</sup> ) (**) |

B. DIPOLE OFFSET , SPHERICAL COORDINATES

|              |        |             |
|--------------|--------|-------------|
| Latitude     | 5.12   | (Deg)       |
| Longitude, W | 155.6  | (Deg) (**)  |
| Magnitude    | 0.1010 | (J.R.) (**) |

C. DIPOLE OFFSET , CARTESIAN COORDINATES

|             |        |             |
|-------------|--------|-------------|
| X-Component | -.0916 | (J.R.) (**) |
| Y-Component | -.0416 | (J.R.)      |
| Z-Component | +.0090 | (J.R.)      |

(\*) After Neil Divine

(\*\*) Jupiter Radii, J.R. = 71372 km,  
for the purposes of Table II

(\*\*\*) A. B. Sergeevsky, Reference 10

## VI. Miscellany

The actions of the Sun and natural satellites on a planet cause variations in the orientation of the equatorial plane, whereas the perturbative effects of the remaining planets produce a variation in the orbit plane. The long-term motions that can be treated as though they are secular (precession) are separated from the short-period motions (nutations). The fictitious equator, orbit and equinox which are defined as being represented by the precessional motions only, are called mean; those affected by both precession and nutation are called true. Values fixed at the time corresponding to a fundamental reference are values at the epoch, whereas those referring to instantaneous moments are the values of date.

The nutations in longitude and obliquity are not well known for any planet other than the Earth. So, they are set to zero for all other bodies. For the Voyager mission, the Sun, Jupiter, Saturn, Uranus, and Neptune celestial body poles are modelled (via user input) as fixed in the EME50 coordinate system. Thus, the equatorial planes of these bodies do not precess. Also, all planet orbit planes in DPTRAJ and ODP are defined by mean elements, thus these planes are mean.

For Saturn, Uranus, Neptune, and Pluto, the hour angle of the true equinox (the right ascension of the prime meridian as measured from the vernal equinox) is adopted as zero on the reference epoch Jan 1.0, 1950 ET.

## VII. Appendix and Attachments

Appendix I describes the quantities printed by the program TWIST, the output link for the trajectory portion of DPTRAJ. The trajectory print quantities are listed as they are printed on the page, subdivided into three groups: the body, conic, and angle groups. The line number, trajectory quantity, and a brief description of the quantity are given.

Also attached are two JPL memoranda. The first describes the epoch 1950.0 ET. The second describes the Jupiter-fixed System III (1965) longitude system and the model for the Jupiter magnetic dipole coordinate system as used on the Voyager project.

## VIII. Suggested Additional References

The following references are suggested for further and more detailed information.

1. Explanatory Supplement to the Ephemeris, Her Majesty's Stationery Office, London, 1961.
2. Melbourne, W. G. et al., "Constants and Related Information for Astrodynamics Calculations, 1968," Technical Report 32-1306, JPL, Pasadena, CA 15 July 1968.

3. Sturms, F. M., Jr., "Polynomial Expressions for Planetary Equators and Orbit Elements with Respect to the Mean 1950.0 Coordinate System," Technical Report 32-508, JPL, Pasadena, CA, 15 January 1971.
4. Spier, G. W., "Design and Implementation of Models for the Double Precision Trajectory Program (DPTRAJ)," Technical Memorandum 33-451, JPL, Pasadena, CA, 15 April 1971.
5. Khatib, A. R., "DPTRAJ Program 1108 Development Phase, Vol. I, Design and Implementation of Models," 900-495, JPL, Pasadena, CA, 30 June 1972.
6. Lieske, J. H., "Recommended Astrodynamical Constants for MJS," IOM 314.8-32, JPL, Pasadena, CA, 19 January 1977.
7. Newhall, X X, "The Epoch 1950.0 ET," IOM 391.8-193, JPL, Pasadena, CA, 6 September 1974.
8. Smith, E. J. et al., "Jupiter's Magnetic Field, Magnetosphere and Interaction with the Solar Wind: Pioneer 11," Science, Vol. 188, 2 May 1975, pps. 451-455.
9. Divine, N., "Evaluation of Jupiter Longitudes in System III (1965)," IOM 3577-76-32, JPL, Pasadena, CA, 30 July 1976.
10. Sergeyevesky, A. B., "Algorithm for Io Flux Tube and Strategy to be Used in Targeting Voyager I," IOM Voyager-NAV-79-012, JPL, Pasadena, CA, 15 January 1979.
11. Dicken, L. H., "Voyager Encounter Lockfile (DPTRAJ)," IOM Voyager-NAV-78-0395, JPL, Pasadena, CA, 7 December 1978.
12. Sturms, F. M., "DPTRAJ Development Plans for Support of Data Records at MJS Encounters," IOM FMS:76-5, JPL, Pasadena, CA, 20 April 1976.

SLH:ii

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# APPENDIX I

## DESCRIPTION OF TRAJECTORY PRINT QUANTITIES

TWIST processes the probe ephemeris file and prints trajectory quantities at user specified events in three formats: body, conic and angle groups. The body group contains the quantities associated with a given body, such as distance from the body, body fixed position and velocity, etc. The conic group contains quantities associated with a conic section, such as classical orbital and asymptotic elements, etc. The angle group contains the angles subtended at the probe by various pairs of celestial objects. This appendix lists and describes the quantities printed in each group.

### I. BODY GROUP

LINE 1 COORDINATE SYSTEM (BODY FIXED)

LINE 2 HANG HOUR ANGLE

LINE 3 XPF } BODY FIXED POSITION VECTOR COMPONENTS OF PROBE WITH RESPECT  
YPF } TO CENTER BODY, KM  
ZPF }

LINE 4 DXPF } BODY FIXED VELOCITY VECTOR COMPONENTS OF PROBE WITH RESPECT  
DYPF } TO CENTER BODY, KM/SEC.  
DZPF }

LINE 5 RP DISTANCE OF PROBE FROM CENTER BODY, KM  
LATP LATITUDE OF PROBE, DEG( $\phi$ )  
LONP LONGITUDE OF PROBE, DEG( $\sigma$ )

LINE 6 VP VELOCITY OF PROBE RELATIVE TO CENTER BODY, KM/SEC  
PTHP BODY FIXED PATH ANGLE OF PROBE, DEG  
AZP BODY FIXED AZIMUTH ANGLE OF PROBE, DEG

LINE 7 COORDINATE SYSTEM(SPACE FIXED)

LINE 8 XP } POSITION VECTOR COMPONENTS OF PROBE WITH RESPECT TO CENTER  
YP } BODY, KM  
ZP }

LINE 9 DXP } VELOCITY VECTOR COMPONENTS OF PROBE WITH RESPECT TO  
DYP } CENTER BODY, KM/SEC  
DZP }

LINE 10 RIP DISTANCE OF PROBE FROM CENTER BODY, KM  
DECP DECLINATION ANGLE OF PROBE( $\phi$ ), DEG  
RAP RIGHT ASCENSION OF PROBE( $\theta$ ), DEG

LINE 11 VIP VELOCITY OF PROBE RELATIVE TO CENTER BODY, KM/SEC  
PTIP PATH ANGLE OF PROBE ( $\tau$ ), DEG  
AZIP AZIMUTH ANGLE OF PROBE ( $\Sigma$ ), DEG

LINE 12 DR RADIAL RATE, KM/SEC  
DP TRANSVERSE ANGULAR VELOCITY, DEG/SEC  
SHA SUN SHADOW PARAMETER P FOR CENTER BODY

LINE 13 ALTP ALTITUDE OF PROBE ABOVE CENTER BODY, KM

LINES PRINTED ONLY IF CENTER IS NOT EARTH

14-18

LINE 14 X300 }  
Y300 } CENTER BODY-EARTH POSITION VECTOR COMPONENTS, KM  
Z300 }

LINE 15 DX300 }  
DY300 } CENTER BODY-EARTH VELOCITY VECTOR COMPONENTS, KM/SEC  
DZ300 }

LINE 16 R300 CENTER BODY-EARTH DISTANCE, KM  
DC300 DECLINATION ANGLE OF EARTH, DEG  
RA300 RIGHT ASCENSION ANGLE OF EARTH, DEG

LINE 17 VI300 VELOCITY OF EARTH RELATIVE TO CENTER BODY, KM/SEC  
V300 CENTER BODY FIXED VELOCITY OF EARTH, KM/SEC  
LN300 LONGITUDE OF EARTH, DEG

LINE 18 SH300 SUN SHADOW PARAMETER P FOR EARTH  
R300P EARTH-PROBE DISTANCE, KM

LINES PRINTED ONLY IF CENTER IS NOT SUN

19-23

LINE 19 XSOL }  
YSOL } CENTER BODY-SUN POSITION VECTOR COMPONENTS, KM  
ZSOL }

LINE 20 DXSOL }  
DYSOL } CENTER BODY-SUN VELOCITY VECTOR COMPONENTS, KM/SEC  
DZSOL }

LINE 21 RSOL CENTER BODY-SUN DISTANCE, KM  
DCSOL DECLINATION ANGLE OF SUN, DEG  
RASOL RIGHT ASCENSION ANGLE OF SUN, DEG

LINE 22 VSOL VELOCITY OF SUN RELATIVE TO CENTER BODY, KM/SEC  
 VSOL CENTER BODY FIXED VELOCITY OF SUN, KM/SEC  
 LNSOL LONGITUDE OF SUN, DEG  
 LINE 23 SHSOL SUN SHADOW PARAMETER P FOR SUN  
 RSOLP SUN-PROBE DISTANCE, KM  
 LINES 24 - 43 ARE THE SAME AS LINES 14-18 FOR UP TO FOUR EXTRA BODIES  
 (TAKEN FROM THE REMAINING 8 PLANETS + MOON LISTED IN  
 APPENDIX A AND THE 33 NATURAL SATELLITES LISTED IN  
 APPENDIX B).

## II. CONIC GROUP

LINE 1 CENTER OF COORDINATE SYSTEM (PLANE INDEPENDENT)  
 LINE 2 SMA SEMIMAJOR AXIS (a), KM  
 ECC ECCENTRICITY (e), UNITLESS  
 SLR SEMILATUS RECTUM, KM  
 LINE 3 B MAGNITUDE OF THE IMPACT PARAMETER VECTOR, KM  
 TFP TIME FROM PERICENTER PASSAGE, SEC  
 TF TIME FROM INJECTION TO PERICENTER PASSAGE, DAYS  
 LINE 4 C3 ENERGY INTEGRAL,  $\text{KM}^2/\text{SEC}^2$   
 C1 ANGULAR MOMENTUM,  $\text{KM}^2/\text{SEC}$   
 RCA CLOSEST APPROACH, KM  
 LINE 5 TA TRUE ANOMALY, DEG  
 MA MEAN ANOMALY, DEG  
 EA ECCENTRIC ANOMALY, DEG  
 LINES PRINTED ONLY IF  $e \geq 1$   
 6-7  
 LINE 6 VH HYPERBOLIC EXCESS VELOCITY, KM/SEC  
 MTA MAXIMUM TRUE ANOMALY, DEG  
 BIR B VECTOR IMPACT RADIUS, KM  
 LINE 7 LFT LINEARIZED FLIGHT TIME, DAYS  
 DEF ANGLE BETWEEN INCOMING AND OUTGOING ASYMPTOTES, DEG  
 EBO ANGLE BETWEEN THE BODY C-EARTH VECTOR AND THE ANGULAR  
 MOMENTUM VECTOR OF THE S/C ORBIT, DEG  
 LINES PRINTED ONLY IF  $e < 1$   
 6A-7A

LINE 6A VA PERICENTRIC VELOCITY, KM/SEC  
 APO APOCENTER DISTANCE, KM  
 CBI JACOBI CONSTANT,  $\text{KM}^2/\text{SEC}^2$   
 LINE 7A PER PERIOD, DAYS  
 EBO Same as PBO in Line 7  
 LINE 8 COORDINATE SYSTEM (PLANE DEPENDENT)  
 LINE 9 XPC }  
 YPC } BODY-PROBE POSITION VECTOR IN COORDINATE SYSTEM GIVEN ABOVE, KM  
 ZPC }  
 LINE 10 DXPC }  
 DYPC } BODY-PROBE VELOCITY VECTOR IN COORDINATE SYSTEM GIVEN  
 DZPC } ABOVE, KM/SEC

NOTE: Velocity components in conic block do not contain rotational components  
 of above coordinate systems, in order to preserve the inertial character  
 of the conic elements

LINE 11 INC INCLINATION OF PROBE ORBIT PLANE TO PLANE GIVEN ABOVE, DEG  
 LAN LONGITUDE OF RIGHT ASCENSION OF ASCENDING NODE, DEG  
 APF ARGUMENT OF PERICENTER, DEG  
 LINE 12 MX }  
 MY } UNIT M VECTOR,  $M = WXN$  WHERE N = UNIT VECTOR IN DIRECTION  
 MZ } OF ASCENDING NODE  
 LINE 13 PX }  
 PY } UNIT P VECTOR - UNIT VECTOR IN DIRECTION OF PERIFOCUS  
 PZ }  
 LINE 14 QX }  
 QY } UNIT Q VECTOR  $Q = WXP$   
 QZ }  
 LINE 15 WX }  
 WY } UNIT W VECTOR - UNIT ANGULAR MOMENTUM VECTOR  
 WZ }  
 LINE 16 BX }  
 BY } UNIT B VECTOR - IMPACT PARAMETER VECTOR  
 BZ }  
 LINE 17 RX }  
 RY } UNIT R VECTOR  
 RZ }

LINE 18 TX }  
           TY } UNIT T VECTOR  
           TZ }

LINE 19 SXI }  
           SYI } UNIT INCOMING ASYMPTOTE VECTOR  
           SZI }

LINE 20 DEI DECLINATION OR LATITUDE OF INCOMING ASYMPTOTE, DEG  
           RAI RIGHT ASCENSION OR LONGITUDE OF INCOMING ASYMPTOTE, DEG  
           GP ANGLE BETWEEN INCOMING ASYMPTOTE AND ITS PROJECTION ON  
               THE ORBIT PLANE OF BODY C, DEG

LINE 21 SKO }  
           SYO } UNIT OUTGOING ASYMPTOTE VECTOR  
           SZO }

LINE 22 DEO LATITUDE OF OUTGOING ASYMPTOTE, DEG  
           RAO LONGITUDE OF OUTGOING ASYMPTOTE, DEG

LINE 23 ETE ANGLE BETWEEN T AND PROJECTION OF EARTH-TARGET VECTOR ON  
               R-T PLANE, DEG  
           ETS ANGLE BETWEEN T AND PROJECTION OF SUN-TARGET VECTOR ON  
               R-T PLANE, DEG  
           ETC ANGLE BETWEEN T AND PROJECTION OF CANOPUS-TARGET VECTOR ON  
               R-T PLANE, DEG

LINE 24 ZAE ANGLE BETWEEN INCOMING ASYMPTOTE AND TARGET-EARTH VECTOR, DEG  
           ZAS ANGLE BETWEEN INCOMING ASYMPTOTE AND TARGET-SUN VECTOR, DEG  
           ZAC ANGLE BETWEEN INCOMING ASYMPTOTE AND TARGET-SUN CANOPUS, DEG

LINE 25 DEP LATITUDE OF ASYMPTOTE, DEG  
           RAPC LONGITUDE OF ASYMPTOTE, DEG  
           EBP PROJECTION OF THE ANGLE BETWEEN THE BODY C-EARTH VECTOR AND  
               THE BODY C-PERIAPSIS VECTOR (PERIAPSIS REFERS TO THAT OF THE  
               S/C ORBIT) ON THE PLANE SPECIFIED BY INPUT, DEG

LINE 26 BDR R COMPONENT OF VECTOR B, KM  
           BDT T COMPONENT OF VECTOR B, KM  
           THA DIRECTION ANGLE OF IMPACT PARAMETER IN R-T PLANE (+FROM T), DEG

### III. ANGLE GROUP

LINE 1 EPS EARTH-PROBE-SUN ANGLE, DEG  
 ESP EARTH-SUN-PROBE ANGLE, DEG  
 SEP SUN-EARTH-PROBE, ANGLE, DEG  
 LINE 2 EPM EARTH-PROBE-MOON ANGLE, DEG  
 EMP EARTH-MOON-PROBE ANGLE, DEG  
 MEP MOON-EARTH-PROBE ANGLE, DEG  
 LINE 3 MPS MOON-PROBE-SUN ANGLE, DEG  
 MSP MOON-SUN-PROBE ANGLE, DEG  
 SMP SUN-MOON-PROBE ANGLE, DEG  
 LINE 4 ESM EARTH-SUN-MOON ANGLE, DEG  
 EMS EARTH-MOON-SUN ANGLE, DEG  
 MES MOON-EARTH-SUN ANGLE, DEG  
 LINE 5 SPNE SUN-PROBE-NEAR LIMB ANGLE OF EARTH, DEG  
 SPNM SUN-PROBE-NEAR LIMB ANGLE OF MOON, DEG  
 CPE CANOPUS-PROBE-EARTH ANGLE, DEG  
 LINE 6 CPS CANOPUS-PROBE-SUN ANGLE, DEG  
 CLEC CANOPUS-CLOCK ANGLE W.R.T. EARTH, DEG  
 CLEM MOON-CLOCK ANGLE W.R.T. EARTH, DEG  
 LINE 7 HNGE HINGE ANGLE OF EARTH, DEG  
 CLCE EARTH-CLOCK ANGLE W.R.T. CANOPUS, DEG  
 CLCM MOON-CLOCK ANGLE W.R.T. CANOPUS, DEG  
 LINE 8 EASD ANGULAR SEMI-DIAMETER OF EARTH FROM S/C, DEG  
 SASD ANGULAR SEMI-DIAMETER OF SUN FROM S/C, DEG  
 MASD ANGULAR SEMI-DIAMETER OF MOON FROM S/C, DEG

LINES 9 - 14 ARE REPEATED FOR UP TO THREE EXTRA BODIES (TAKEN FROM THE  
 REMAINING 8 PLANETS LISTED IN APPENDIX A AND THE 33 NATURAL  
 SATELLITES LISTED IN APPENDIX B), WHERE i IS A THREE DIGIT  
 INTEGER SPECIFYING THE BODY.

LINE 9 EPi EARTH-PROBE-BODY i ANGLE, DEG  
 EiP EARTH-BODY i-PROBE ANGLE, DEG  
 AiEP BODY i-EARTH-PROBE ANGLE, DEG  
 LINE 10 AiPS BODY i-PROBE-SUN ANGLE, DEG  
 AiSP BODY i-SUN-PROBE ANGLE, DEG  
 SiP SUN-BODY i-PROBE ANGLE, DEG  
 LINE 11 SEi SUN-EARTH-BODY i ANGLE, DEG  
 SiE SUN-BODY i-EARTH ANGLE, DEG  
 ESi EARTH-SUN-BODY i ANGLE, DEG

LINE 12 CP1 CANOPUS-PROBE-BODY 1 ANGLE, DEG  
EPN1 EARTH-PROBE-NEAR LIMB ANGLE OF BODY 1, DEG  
CPN1 CANOPUS-PROBE-NEAR LIMB ANGLE OF BODY 1, DEG  
LINE 13 ASD1 ANGULAR SEMI-DIAMETER OF BODY 1 FROM S/C, DEG  
SPN1 SUN-PROBE-NEAR LIMB ANGLE OF BODY 1, DEG  
CLE1 BODY 1-CLOCK ANGLE W.R.T. EARTH, DEG  
LINE 14 CLC1 BODY 1-CLOCK ANGLE W.R.T. CANOPUS, DEG  
HNG1 HINGE ANGLE OF BODY 1, DEG  
SVL1 SWIVEL ANGLE OF BODY 1, DEG

JET PROPULSION LABORATORY

INTEROFFICE MEMORANDUM

391.8-193

6 September 1974

TO: Distribution  
FROM: X X Newhall  
SUBJECT: The Epoch 1950.0 ET

Throughout navigation software, calculations are done with reference to a non-rotating Cartesian coordinate system. By convention the reference direction of the x-axis is toward the point in the sky that was occupied by the vernal equinox at an instant of time denoted as 1950.0 ET. By definition, that event occurred when the right ascension of the fictitious mean sun was exactly  $10^{\text{h}}40^{\text{m}}$  ( $280^{\circ}$ ). (It is not the same as the epoch  $C^{\text{A}}$ , Jan. 1, 1950 ET.)

A transformation of these coordinates depends on the interval of ephemeris time that has elapsed between 1950.0 ET and the JED (Julian ephemeris date) of the epoch in question. The JED of 1950.0 ET has been determined to the limits of 1103 precision. It is:

$$1950.0 \text{ ET} = \text{JED } 2433282.423357370692$$

(which translates to calendar date

Dec. 31, 1949 22:09:38.076827794 ET).

For consistency of numerical results, it is suggested that all navigation programs which have the epoch 1950.0 ET defined internally use the above JED.

XXN:sb

Distribution

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JPL PROPULSION LABORATORY

INTEROFFICE MEMORANDUM  
3577-76-32

30 July 1976

To: J. R. Hyde  
 From: Neil Divine  
 Subject: Evaluation of Jupiter Longitudes in System III(1965)

The attached pages describe a new longitude system which is expected to become standard for radio, charged particle, and field measurements of Jupiter after consideration by the IAU in August. I recommend its adoption now by JOP for trajectory computations as well as for the above purposes. Should there be any numerical changes as a result of action by the IAU, they will be included in a revised memo with the same distribution (below).

Suggested distribution outside JPL includes N. S. Vojvodich, R. W. Schaupp, E. L. Tindle, and J. W. Dyer at Ames Research Center.




---

Neil Divine  
 Natural Space Environments

ND:hem

cc: A. B. Beck  
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EVALUATION OF JUPITER LONGITUDES  
IN SYSTEM III(1965)

*Neil Divine*  
*Environmental Requirements Section 294*  
*Jet Propulsion Laboratory*

30 July 1976

1. INTRODUCTION

Riddle and Warwick (1976) suggest a new longitude system for Jupiter to replace System III(1957.0) as the standard for radio, charged particle, and field measurements. The latter system uses a rotation rate differing from that of Jupiter's radio sources by about 3 degrees/year, and its evaluation has been compromised by various computational problems. The new system, to be known as System III(1965), will be recommended (with slight modifications) to Commission 40 of the International Astronomical Union at the IAU General Assembly in Grenoble, France, August 1976. Its endorsement by those most active in the above fields suggests its likely adoption by the IAU and the American Ephemeris and Nautical Almanac, so it is probably appropriate for immediate and continuing use in trajectory computations as well.

## 2. DEFINITIONS OF LONGITUDE SYSTEMS

Table 1 includes the definitions of four Jupiter longitude systems, three of them in prior use, and the new one. Even with extensive notes (1 through 8), these definitions require detailed tables of the ephemerides of Jupiter, Earth, and/or spacecraft for their practical utilization for observational or trajectory purposes (see Sections 3 through 6, below).

The rotation period for System III (1965) shown in Table 1 has been assigned an uncertainty which corresponds to  $\pm 1$  in the last digit of the defining rotation rate, and is in excellent accord with the value and uncertainty of the best determinations of the radio rotation period, as observed over a several year interval including the epoch (Riddle and Warwick 1976). The CML and epoch are taken from a recent letter from Seidelman (1976) to Parijskij which recommends a resolution for adoption by Commission 40 of the International Astronomical Union; they differ from that given by Riddle and Warwick (1976) in that the epoch is zero hours ET rather than UT (the definitions are equivalent except for a longitude difference of approximately  $0^{\circ}001$ ).

Although two approximate system coincidences were deliberate and are described in note (7) for Table 1, they should not be used for computational purposes in place of the definitions, particularly since they both involve System III (1957.0) for which numerical errors have been common (Riddle and Warwick 1976).

Table 1. BASIC QUANTITIES FOR JUPITER LONGITUDE SYSTEMS

|                                 | SYSTEM I   | SYSTEM II   | SYSTEM III(1957.0)   | SYSTEM III(1965)  |
|---------------------------------|--|---|--|---|
| ROTATION PERIOD (3)             | $9^{\text{h}}50^{\text{m}}30^{\text{s}}.0034$<br>(2)   | $9^{\text{h}}55^{\text{m}}40^{\text{s}}.6322$<br>(2)  | $9^{\text{h}}55^{\text{m}}29^{\text{s}}.370$<br>(1)  | $9^{\text{h}}55^{\text{m}}29^{\text{s}}.71140^{\text{s}}.04$<br>(2,6) |
| ROTATION RATE (degrees/day) (3) | 877.900<br>$\Delta = -7.6$<br>(1)  | 870.270<br>$\Delta = -14.7$<br>(1)  | 870.5443169<br>$\Delta = -2.2$<br>(2)  | 870.536<br>(1)  |
| CHL. AT EPOCH (degrees) (4,5)   | 47.310<br>(1)  | 96.580<br>(1,7)   | 108.020<br>(1,7)   | 217.595<br>(1,7)  |
| EPOCH                           | 1897 July 14, 12 <sup>h</sup> 00 <sup>m</sup> 00 <sup>s</sup> .0 UT<br>$= t_1 = \text{JED } 2414120.0$ | 1957 Jan 1, 00 <sup>h</sup> 00 <sup>m</sup> 00 <sup>s</sup> .0 UT<br>$= t_3 = \text{JED } 2435839.50036655$ | 1965 Jan 1, 00 <sup>h</sup> 00 <sup>m</sup> 00 <sup>s</sup> .0 ET<br>$= t_4 = \text{JED } 2438761.5$ |   |
| REFERENCE                       | EXPLANATORY SUPPLEMENT<br>(Gurnette & Woolley, 1961)   |   |  | Seidelmann (1976)   |

(1) These entries represent exact numerical definitions. In the case of  $t_1$ , the original definition implies JD = 2414120.0, but in practice this has been interpreted as a JED epoch.

(2) These entries represent approximate values derived from the definitions.

(3) One sidereal rotation is interpreted for this purpose as 360 degrees between successive meridian transits of the direction of Jupiter's Vernal Equinox; time unit is based on one day of 86400 Ephemeris seconds.

(4) The longitude (in the system of interest) of the central meridian of Jupiter's geometric (not apparent illuminated) disk, as it would be observed from Earth at the epoch, i.e., at the time the light signal arrives at Earth from Jupiter.

(5) These longitudes imply a prime meridian for each System at Jupiter, from which all longitudes are measured positive west, i.e., increasing clockwise as viewed from the north pole of Jupiter's rotation. Thus observed CHL increases with time, and the longitude is opposite in sense to the usual azimuthal angle in a right-handed coordinate system whose positive Z-axis has the direction of Jupiter's north rotational pole.

(6) See text, sec. 2, paragraph 2.

(7) System III(1957.0) approximately coincides with System II at epoch  $t_3$ , and with System III(1965) at epoch  $t_4$ ; see text, sec. 2, paragraph 3, and eq. (6b) and (7c).

## 3. LONGITUDE EVALUATION

The evaluation of longitudes in the various Jupiter Systems can be realized by use of Jupiter's Vernal Equinox (JVE) as a reference direction; for the coordinates of the latter, appropriate specifications are provided in the EXPLANATORY SUPPLEMENT (Gurnette and Woolley, 1961), Melbourne *et al.* (1968), and Sturms (1971). In System I, the longitude  $V_I$  of JVE is specified in the EXPLANATORY SUPPLEMENT (1961, and corrected, 1968) in the form

$$V_I = 281^{\circ}001 + (877.900)(t-t_1) \quad (1)$$

at time  $t$  (in Julian Ephemeris Days;  $t_1$  is given in Table 1). In System II, the longitude of JVE, from the same source, is

$$V_{II} = 330^{\circ}002 + (870.270)(t-t_1) \quad (2)$$

Note that the rotation rates from Table 1 (row 3) are included directly in these formulae, but that the longitude difference implied by the above constants is not identical to that from Table 1 (row 4) because of differential rotation among the systems during the light travel time, Jupiter to Earth.

In System III(1957.0), the longitude of JVE has been derived (from the definitions and ephemerides) by Seidelmann (1976) in a form equivalent to

$$V_{III(1957.0)} = 359^{\circ}270 + (870.5443169)(t-t_3) \quad (3)$$

This differs slightly from the result given by Mead (1974), who has used fewer digits in the rotation rate and epoch, and the approximate coincidence with System II (Table 1, note 7, and sec. 2, para. 3, above). Note also that the epoch  $t_3$  has been interpreted by some authors as zero hours ET rather than UT (see Table 1), leading to a 0.3 degree difference in the constant in equation (3).

Lastly, in System III (1965), the longitude of JVE may be derived directly from the definition and the computation by Seidelmann (1976) in the form

$$V_{\text{III}(1965)} = 3299452 + (870.536)(t-t_u) \quad (4)$$

Equations (1) through (4) are the basis for Jupiter longitude evaluation both for earth-based observations and spacecraft trajectories. For the latter, see Section 5 below. For the former, the American Ephemeris and Nautical Almanac evaluates CML (see Table 1, note 4) for Systems I and II by a technique involving the equivalents of the above equations and the ephemerides of Jupiter and the Earth, as illustrated by example 11.8 in the EXPLANATORY SUPPLEMENT (1961, and corrected, 1968). Note, however, that there have been minor problems in the CML calculations for System III(1957.0) longitudes as published in US Naval Observatory Circulars (Riddle and Warwick, 1976, and Douglas' discussion at the end thereof). Such problems will hopefully be avoided when ephemerides for System III(1965) are published.

## 4. TRANSFORMATIONS AMONG THE SYSTEMS

For objects and directions at Jupiter, transformations among the four longitude systems are linear in time and may be derived simply from differences among equations (1) through (4), in which times at the epochs  $t_1$  through  $t_4$  are evaluated using the JED entries in Table I. For longitudes  $\ell$  in degrees in the systems indicated by the subscripts, and for time  $t$  at Jupiter in Julian Ephemeris Day (JED), the results are

$$\ell_{II} = \ell_I + 49.001^\circ - (7.630)(t-t_1) \quad (5)$$

$$\ell_{III(1957.0)} = \ell_I + 288.897^\circ - (7.3556831)(t-t_3) \quad (6a)$$

$$= \ell_{II} - 0.316^\circ + (0.2743169)(t-t_3) \quad (6b)$$

$$\ell_{III(1965)} = \ell_I + 35.601^\circ - (7.364)(t-t_4) \quad (7a)$$

$$= \ell_{II} + 81.245^\circ + (0.266)(t-t_4) \quad (7b)$$

$$= \ell_{III(1957.0)} + 0.007^\circ - (0.0083169)(t-t_4) \quad (7c)$$

These equations may be compared with similar equations provided by Mead (1974), Riddle and Warwick (1976), and Davis (1976). The minor differences result from the use in the above equations of (1) addition of arbitrary multiples of  $360^\circ$ , (2) times in JED exclusively (not in JD; note that  $t_3$  requires several decimal places), (3) sufficient digits to yield results precise to millidegrees, and (4) definitions rather than coincidences where System III(1957.0) (and its computational problems; see above) is involved (note the small but non-zero constants in eq. 6b and 7c).

For observations from Earth, longitude transformations differ slightly from the above and are not strictly linear in time because of differential rotation among the systems during the variable light travel

time, Jupiter to Earth. Where System I is involved the maximum correction and non-linearity are about 0.3 and 0.1 degrees respectively; otherwise, they are about 0.01 and 0.004 degrees respectively.

## 5. APPLICATIONS

Trajectory programs at JPL use the reference time 1950 Jan 1, 00<sup>h</sup>00<sup>m</sup>00<sup>s</sup>.0 ET =  $t_2$  = JED 2433282.5 (Sturms, 1971).<sup>\*</sup> With the common reference time  $t_2$ , equations (1) through (4) become, for longitudes positive west,

$$\left. \begin{array}{l} v_I \\ v_{II} \end{array} \right\} \begin{array}{l} \text{Jovian} \\ \text{Surface} \end{array} = 239.751 + (877.900)(t-t_2) \quad \pm 16^\circ \quad (8)$$

$$= 238.877 + (870.270)(t-t_2) \quad 10^\circ-20^\circ \quad (9)$$

$$v_{III(1957.0)} = 257.133 + (870.5443169)(t-t_2) \quad \text{obsolete} \quad (10)$$

$$\text{and } v_{III(1965)} = 302.708 + (870.536)(t-t_2) \quad (11)$$

Equation (8) is identical to the last entry in Table 5 of Sturms (1971), and equations (9) through (11) are its equivalents in the other systems. Differences among equations (8) through (11) yield the equivalents of equations (5) through (7) for time arguments with respect to the reference time  $t_2$  (sometimes more convenient than eq. 5 through 7).

To further illustrate the application of System III(1965) consider the longitudes of Pioneer 10 and 11 at perijove shown in Table 2. Azimuthal angles in System I (i.e.,  $360^\circ - \ell_I$ ; see Table 1, note 5) were provided by Jack Dyer (1976) at Ames Research Center from computations performed at JPL using DPTRAJ. The remaining longitudes were calculated using equations (5) through (7).

\* The programs also use azimuthal angles (positive east; see Table 1, note 5) and inertial coordinates with respect to the mean Earth equator and equinox of 1950.0, not of date.

Table 2. LONGITUDES OF PIONEER SPACECRAFT AT PERIJOVE

|                                | PIONEER 10  | PIONEER 11  |
|--------------------------------|---|---|
| TIME, $t$                      | 1973 Dec 4, 02 <sup>h</sup> 26 <sup>m</sup> 12 <sup>s</sup> .15 ET<br>= JED 2442020.6015295 | 1974 Dec 3, 05 <sup>h</sup> 22 <sup>m</sup> 19 <sup>s</sup> .25 ET<br>= JED 2442384.7238339 |
| AZIMUTHAL ANGLE<br>IN SYSTEM I | 295°68  | 26°30   |
| LONGITUDE IN SYSTEM I          | 64°32   | 333°70  |
| SYSTEM II                      | 351°73  | 2°86  |
| SYSTEM III(1957.0)             | 247°00  | 358°01  |
| SYSTEM III(1965)               | 219°90  | 327°88  |

Lastly, consider the specification of the offset, tilted magnetic dipole D<sub>4</sub> defined by Smith *et al.* (1975). Table 3 includes its polar and cartesian representations in two longitude systems, System III(1957.0) at the time of Pioneer 11 perijove (agrees with its specification in System P11J of Smith *et al.*, 1976), and in System III(1965), independent of time (agrees with its specification by Davis, 1976). Any system of Jupiter magnetic coordinates (e.g., one based on the dipole D<sub>4</sub> as specified in the last column of Table 3) rotates at very closely the same rate as System III(1965), which is appropriate for the analysis of particle, field, and radio data for Jupiter.

Table 3. REPRESENTATIONS OF OFFSET, TILTED MAGNETIC DIPOLE MODEL D4

|                              |                                      | SYSTEM III(1957.0)* | SYSTEM III(1965) |
|------------------------------|--------------------------------------|---------------------|------------------|
| DIPOLE<br>OFFSET<br>VECTOR   | Latitude (deg) $\rho_{OFF}$          | 5.12                | 5.12             |
|                              | Longitude (deg) $\lambda_{OFF}$      | 185.7               | 155.5            |
|                              | Magnitude ( $R_J$ ) $D$ (2.25)       | 0.1010              | 0.1010           |
|                              |                                      | 7201.572            |                  |
| Components ( $R_J$ )         | X                                    | -0.1002             | -0.0916          |
|                              | Y                                    | +0.0100             | -0.0416          |
|                              | Z                                    | +0.0090             | +0.0090          |
| MAGNETIC<br>MOMENT<br>VECTOR | Tilt Colatitude (deg) $\delta_{MAG}$ | 10.77               | 10.77            |
|                              | Longitude (deg) $\lambda_{MAG}$      | 230.9               | 200.8            |
|                              | Magnitude (gauss- $R_J^3$ )          | 4.225               | 4.225            |
|                              | Components (gauss- $R_J^3$ )         | $M_x$               | -0.498           |
| $M_y$                        |                                      | +0.613              | +0.280           |
| $M_z$                        |                                      | +4.151              | +4.151           |

\* At  $t = \text{JED } 2442384.5$ , i.e.,  $0^h$  on day of Pioneer 11 perijove.

Dec 3, 1974

(E. J. ...)

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## Pointing Vector Data Block Format

| WORD    | DESCRIPTION  | UNITS | TYPE |
|---------|--|-------|------|
| 73-74   | S/C Clock and Cone Angles of the PLS Axis of Symmetry  | deg   | E    |
| 75-77   | Cartesian Unit Vector of the PLS Axis of Symmetry, Earth True Equinox and Ecliptic of Date                             | dim   | E    |
| 78-79   | S/C Clock and Cone Angles of the PLS Lateral Detector Boresight  | deg   | E    |
| 80-82   | Cartesian Unit Vector of the PLS Lateral Detector Boresight, Earth True Equinox and Ecliptic of Date                   | dim   | E    |
| 83-84   | S/C Clock and Cone Angles of the HGA Boresight   | deg   | E    |
| 85-87   | Cartesian Unit Vector of the HGA Boresight, Earth True Equinox and Ecliptic of Date                                    | dim   | E    |
| 88-89   | S/C Clock and Cone Angles of the PPS Optic Axis  | deg   | E    |
| 90-92   | Cartesian Unit Vector of the PPS Optic Axis, Earth True Equinox and Ecliptic of Date                                   | dim   | E    |
| 93-94   | S/C Clock and Cone Angles of the UVS Airglow Optic Axis  | deg   | E    |
| 95-97   | Cartesian Unit Vector of the UVS Airglow Optic Axis, Earth True Equinox and Ecliptic of Date                           | dim   | E    |
| 98-99   | S/C Clock and Cone Angles of the IRIS Optic Axis   | deg   | E    |
| 100-102 | Cartesian Unit Vector of the IRIS Optic Axis, Earth True Equinox and Ecliptic of Date                                  | dim   | E    |
| 103     | Continuation Bit: = 1, another pointing vector block follows<br>= 0, last pointing vector block in this logical record | dim   | I    |
| 104-126 | Spares   |       |      |
|         |  |       |      |
|         |  |       |      |
|         |  |       |      |
|         |  |       |      |
|         |  |       |      |

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## SOFTWARE INTERFACE SPECIFICATION

## GENERATING

PROGRAM: SEDRGEN

## USER

PROGRAM: Fixed Instrument PI  
SEDR Processors

## COMPUTER

SYSTEM: UNIVAC 1108

## COMPUTER

SYSTEM:

## PURPOSE OF INTERFACE

To provide the fixed instrument Principle Investigators with the conditions under which their scientific observations were made.

## INTERFACE DEVICE

Magnetic tape of seven and nine tracks written at tape density of 800BPI using odd lateral parity. The tape will contain will contain a single file termed "Fixed Instrument SEDR File".

## DATA CODE

The Fixed Instrument SEDR will contain character, integer and floating point quantities as specified in the attached formats. All character data will be IBM EBCDIC coded. All integer quantities will be in the 2's complement form. The floating point words will be in the standard IBM360 format. This format is described briefly below.

|       |      |      |          |   |    |
|-------|------|------|----------|---|----|
| Bit → | 0    | 1    | 7        | 8 | 31 |
|       | SIGN | CHAR | FRACTION |   |    |

Where,

- SIGN** indicates the sign of the quantity. If SIGN = 0, the quantity is positive. If SIGN = 1, the quantity is negative.
- CHAR** indicates the power of ten the FRACTION portion of the quantity must be multiplied by to properly place the decimal point. This quantity is normalized to a value of  $64_{10}$  with higher numbers moving the decimal point to the right and lower numbers moving it to the left.
- FRACTION** contains the significant digits of the quantity and should be evaluated as a decimal number with the decimal point to the left of bit 8.

The following algorithm indicates how floating point quantities could be evaluated from this format:

$$\text{VALUE} = ( 1. - 2*\text{SIGN} ) * ( .\text{FRACTION}_{10} ) * 10 ** ( \text{CHAR} - 64 )$$

---

#### RECORDING METHOD

UNIVAC 1108 System Library Routine, IOW (binary read/write routine)

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#### DETAILED INTERFACE DEFINITION/FORMAT

The SEDRGEN Program will write a nine (9) track magnetic tape for the CRS, PRA, PLS, MAG, LECP, RSS, IRIS, PPS and UVS PIs and a seven (7) track magnetic tape for the PWS PI. All words will be 32 bits in length and all physical records except for the header record will contain the same number of words for any single SEDR. The following attachments to this document describes the structure and content of the fixed instrument SEDR file.

- Attachment A Fixed Instrument SEDR File Layout
- Attachment B Fixed Instrument SEDR Header Record Format
- Attachment C Navigation Data Block Format for Cruise Periods
- Attachment D Navigation Data Block Format for Jupiter Encounter
- Attachment E Navigation Data Block Format for Saturn Encounter
- Attachment F Pointing Vector Data Block Format

The following notes apply to the data described in Appendices C - F:

Cartesian State refers to both position and velocity components.

All clock and cone angles are relative to the Sun-S/C-Canopus system.

ATTACHMENT A

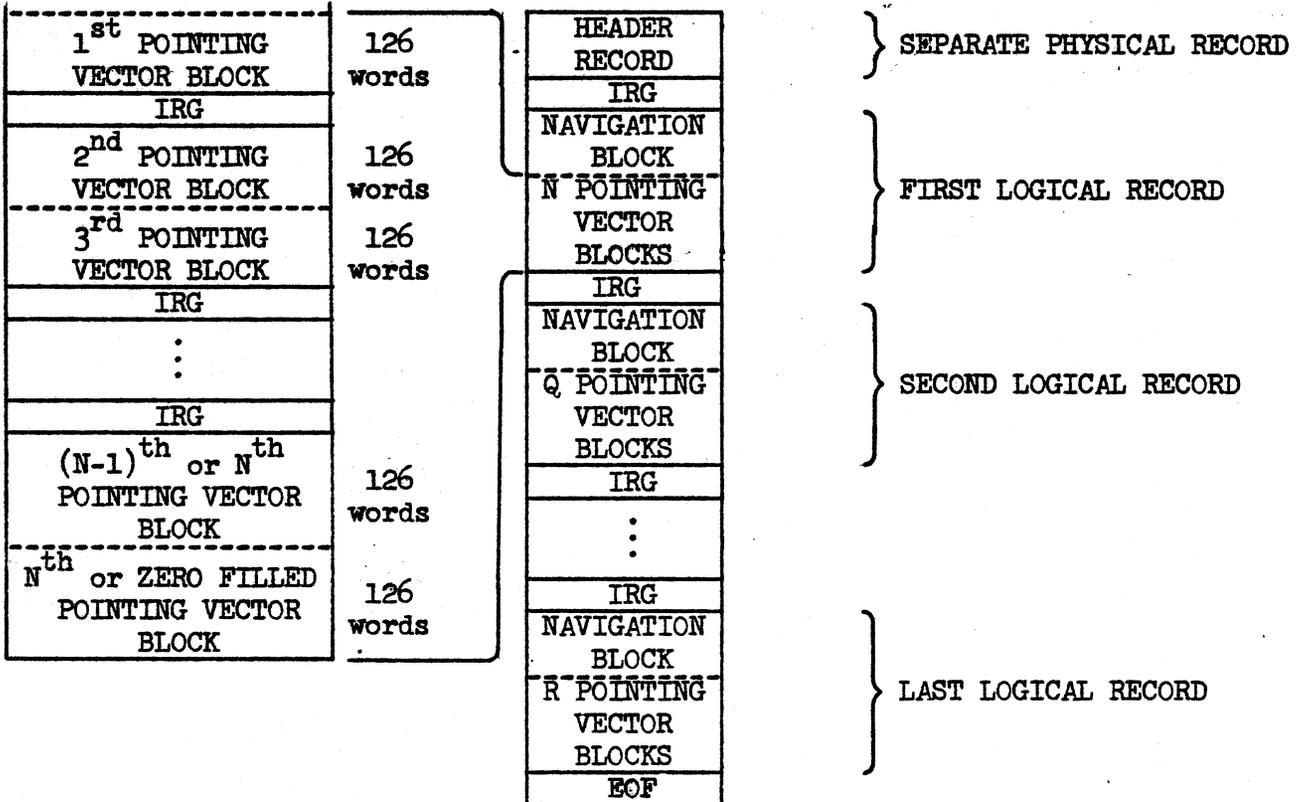
Fixed Instrument SEDR

File Layout

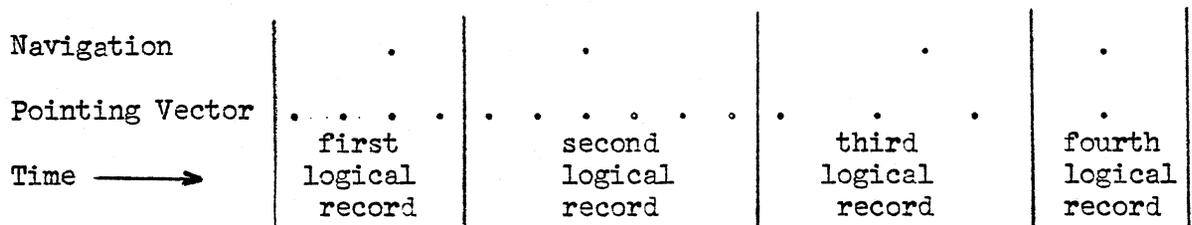
Attachment A

Fixed Instrument SEDR  
File Layout

The following SEDR file (tape) layout represents the common file structure that will be supplied to fixed instrument Principle Investigators (PIs) of the MJS77 mission.



Each logical record will contain one navigation data block (one set of navigation data effective at a particular time) and all pointing vector data blocks associated with it. This association is determined by time such that the times of the pointing vector blocks in any logical record are closer to that logical record's navigation block time than any other navigation block time on the SEDR. The following figure illustrates how SEDR logical records would be formed given an arbitrary set of navigation and pointing vector times. Note that the navigation block is always the



## Attachment A

first data in the logical record even though some of the pointing vector blocks may have earlier times. However, the navigation and pointing vector blocks taken as individual sets will always be in increasing time order.

Each logical record will be composed of an integral number of physical records. Also, each physical record will contain an integral number of 126 word logical blocks. The number of these blocks for each physical record will be determined from the size of the navigation data block and one pointing vector block. For cruise and Saturn encounter, the navigation data block occupies one logical block while the Jupiter encounter navigation block requires two logical blocks. The pointing vector block is mission phase independent and always occupies one logical block. Therefore, the physical record size for cruise and Saturn encounter is 2 logical blocks or 252 words while Jupiter encounter requires 3 logical blocks or 378 words. When multiple pointing vector blocks exist in a logical record, these data are filled into as many additional physical records as are required to contain the logical record. Each pointing vector block will contain a continuation bit which indicates if that pointing vector block is the last block in the logical record. If the last physical record is not evenly filled with pointing vector blocks, the remainder of the record will be zero filled. The lefthand portion of the file format presented at the start of this attachment illustrates the physical record - logical record structure/relationship for the cruise or Saturn encounter format. The Jupiter encounter format would be similar except that the physical records would contain three 126 word blocks instead of two.

ATTACHMENT B

Fixed Instrument SEDR

Header Record Format

## Fixed Instrument SEDR Header Record Format

| WORD  | DESCRIPTION   | UNITS            | TYPE   |
|-------|---|------------------|--------|
| 1     | Project Identification                                  | 'MJS'            | EBCDIC |
| 2     | File Identification                                     | 'SEDR'           | EBCDIC |
| 3     | S/C Identification                                      | 'K'<br>or<br>'L' | EBCDIC |
| 4     | File Generation Date                                    | MMDDYY           | I      |
| 5     | File Generation Time                                    | HHMMSS           | I      |
| 6-7   | Pointing Vector (FIP) File Identification (Tape Number) |                  | EBCDIC |
| 8     | FIP File Generation Date                                | MMDDYY           | I      |
| 9     | FIP File Generation Time                                | HHMMSS           | I      |
| 10-11 | Navigation (DPTRAJ) File Identification (Tape Number)   |                  | EBCDIC |
| 12    | DPTRAJ File Generation Date                             | MMDDYY           | I      |
| 13    | DPTRAJ File Generation Time                             | HHMMSS           | I      |
| 14    | DPTRAJ Orbit Solution Identification                    |                  | EBCDIC |
| 15-19 | Same as 10-14 for Second DPTRAJ File Tape               |                  |        |
| 20-24 | Same as 10-14 for Third DPTRAJ File Tape                |                  |        |
| 25-29 | Same as 10-14 for Fourth DPTRAJ File Tape               |                  |        |
| 30-45 | Spares  |                  |        |
|       |   |                  |        |
|       |   |                  |        |

ATTACHMENT C

Navigation Data Block Format  
for Cruise Periods

## Attachment C

## Navigation Data Block Format for Cruise Periods

| WORD  | DESCRIPTION   | UNITS               | TYPE   |
|-------|---|---------------------|--------|
| 1     | GMT Year of Navigation Data Block   | years,<br>AD        | I      |
| 2     | GMT Day of Navigation Data Block  | day of<br>year      | I      |
| 3     | GMT Hour of Navigation Data Block   | hour of<br>day      | I      |
| 4     | GMT Minute of Navigation Data Block   | minute<br>of hour   | I      |
| 5     | GMT Second of Navigation Data Block   | second of<br>minute | I      |
| 6     | GMT Millisecond (Msec) of Navigation Data Block                                     | msec of<br>second   | I      |
| 7-12  | Cartesian State of S/C, Earth Centered, Earth True Equinox and Ecliptic of Date     | km<br>km/sec        | E<br>E |
| 13-18 | Cartesian State of S/C, Sun Centered, Earth True Equinox and Ecliptic of Date       | km<br>km/sec        | E<br>E |
| 19-24 | Cartesian State of Earth, Sun Centered, Earth True Equinox and Ecliptic of Date     | km<br>km/sec        | E<br>E |
| 25-30 | Cartesian State of Jupiter, Sun Centered, Earth True Equinox and Ecliptic of Date   | km<br>km/sec        | E<br>E |
| 31-36 | Cartesian State of Saturn, Sun Centered, Earth True Equinox and Ecliptic of Date    | km<br>km/sec        | E<br>E |
| 37-42 | Cartesian State of S/C, Jupiter Centered, Earth True Equinox and Ecliptic of Date   | km<br>km/sec        | E<br>E |
| 43-48 | Cartesian State of Earth, Jupiter Centered, Earth True Equinox and Ecliptic of Date | km<br>km/sec        | E<br>E |
| 49-54 | Cartesian State of S/C, Saturn Centered, Earth True Equinox and Ecliptic of Date    | km<br>km/sec        | E<br>E |
| 55-60 | Cartesian State of Earth, Saturn Centered, Earth True Equinox and Ecliptic of Date  | km<br>km/sec        | E<br>E |
| 61    | Range Earth - S/C   | km                  | E      |
| 62    | Range Sun - S/C   | km                  | E      |
| 63    | Range Sun - Earth   | km                  | E      |

## Attachment C

## Navigation Data Block Format for Cruise Periods

| WORD  | DESCRIPTION  | UNITS | TYPE |
|-------|--|-------|------|
| 64    | Range Sun - Jupiter                                    | km    | E    |
| 65    | Range Sun - Saturn                                     | km    | E    |
| 66    | Range Jupiter - S/C                                    | km    | E    |
| 67    | Range Saturn - S/C                                     | km    | E    |
| 68    | Angle Earth - Sun - S/C                                | deg   | E    |
| 69    | Angle Sun - S/C - Earth (S/C Cone Angle of Earth)      | deg   | E    |
| 70    | Angle Sun - Earth - S/C                                | deg   | E    |
| 71    | Angle Jupiter - Sun - S/C                              | deg   | E    |
| 72    | Angle Sun - S/C - Jupiter ( S/C Cone Angle of Jupiter) | deg   | E    |
| 73    | Angle Sun - Jupiter - S/C                              | deg   | E    |
| 74    | Angle Saturn - Sun - S/C                               | deg   | E    |
| 75    | Angle Sun - S/C - Saturn (S/C Cone Angle of Saturn)    | deg   | E    |
| 76    | Angle Sun - Saturn - S/C                               | deg   | E    |
| 77    | S/C Clock Angle of Earth                               | deg   | E    |
| 78    | S/C Clock Angle of Jupiter                             | deg   | E    |
| 79    | S/C Clock Angle of Saturn                              | deg   | E    |
| 80-81 | Earth Right Ascension and Declination of S/C           | deg   | E    |
| 82-83 | Earth Right Ascension and Declination of Sun           | deg   | E    |



ATTACHMENT D

Navigation Data Block Format  
for Jupiter Encounter

## Navigation Data Block Format for Jupiter Encounter

| WORD  | DESCRIPTION  | UNITS               | TYPE   |
|-------|--|---------------------|--------|
| 1     | GMT Year of Navigation Data Block  | years,<br>AD        | I      |
| 2     | GMT Day of Navigation Data Block   | day of<br>year      | I      |
| 3     | GMT Hour of Navigation Data Block  | hour of<br>day      | I      |
| 4     | GMT Minute of Navigation Data Block  | minute<br>of hour   | I      |
| 5     | GMT Second of Navigation Data Block  | second of<br>minute | I      |
| 6     | GMT Millisecond (Msec) of Navigation Data Block  | msec of<br>second   | I      |
| 7-12  | Cartesian State of S/C, Earth Centered, Earth True Equinox and Ecliptic of Date        | km<br>km/sec        | E<br>E |
| 13-18 | Cartesian State of S/C, Sun Centered, Earth True Equinox and Ecliptic of Date          | km<br>km/sec        | E<br>E |
| 19-24 | Cartesian State of Earth, Sun Centered, Earth True Equinox and Ecliptic of Date        | km<br>km/sec        | E<br>E |
| 25-30 | Cartesian State of Jupiter, Sun Centered, Earth True Equinox and Ecliptic of Date      | km<br>km/sec        | E<br>E |
| 31-36 | Cartesian State of S/C, Jupiter Centered, Earth True Equinox and Ecliptic of Date      | km<br>km/sec        | E<br>E |
| 37-42 | Cartesian State of Earth, Jupiter Centered, Earth True Equinox and Ecliptic of Date    | km<br>km/sec        | E<br>E |
| 43-48 | Cartesian State of S/C, Io Centered, Earth True Equinox and Ecliptic of Date           | km<br>km/sec        | E<br>E |
| 49-54 | Cartesian State of Jupiter, Io Centered, Earth True Equinox and Ecliptic of Date       | km<br>km/sec        | E<br>E |
| 55-60 | Cartesian State of S/C, Ganymede Centered, Earth True Equinox and Ecliptic of Date     | km<br>km/sec        | E<br>E |
| 61-66 | Cartesian State of Jupiter, Ganymede Centered, Earth True Equinox and Ecliptic of Date | km<br>km/sec        | E<br>E |
| 67-72 | Cartesian State of S/C, Callisto Centered, Earth True Equinox and Ecliptic of Date     | km<br>km/sec        | E<br>E |
| 73-78 | Cartesian State of Jupiter, Callisto Centered, Earth True Equinox and Ecliptic of Date | km<br>km/sec        | E<br>E |

## Attachment D

## Navigation Data Block Format for Jupiter Encounter

| WORD    | DESCRIPTION   | UNITS        | TYPE   |
|---------|---|--------------|--------|
| 79-84   | Cartesian State of S/C, Jupiter Centered, Jupiter Mean Orbit and Prime Meridian in Sun Direction      | km<br>km/sec | E<br>E |
| 85-90   | Cartesian State of Io, Jupiter Centered, Jupiter Mean Orbit and Prime Meridian in Sun Direction       | km<br>km/sec | E<br>E |
| 91-96   | Cartesian State of Europa, Jupiter Centered, Jupiter Mean Orbit and Prime Meridian in Sun Direction   | km<br>km/sec | E<br>E |
| 97-102  | Cartesian State of Ganymede, Jupiter Centered, Jupiter Mean Orbit and Prime Meridian in Sun Direction | km<br>km/sec | E<br>E |
| 103-108 | Cartesian State of Callisto, Jupiter Centered, Jupiter Mean Orbit and Prime Meridian in Sun Direction | km<br>km/sec | E<br>E |
| 109-114 | Cartesian State of S/C, Jupiter Centered, Jupiter System I True Equinox and Equator of Date           | km<br>km/sec | E<br>E |
| 115-117 | Cartesian Position of Io, Jupiter Centered, Jupiter System I True Equinox and Equator of Date         | km           | E      |
| 118-120 | Cartesian Position of Europa, Jupiter Centered, Jupiter System I True Equinox and Equator of Date     | km           | E      |
| 121-123 | Cartesian Position of Ganymede, Jupiter Centered, Jupiter System I True Equinox and Equator of Date   | km           | E      |
| 124-126 | Cartesian Position of Callisto, Jupiter Centered, Jupiter System I True Equinox and Equator of Date   | km           | E      |
| 127-132 | Cartesian State of S/C, Jupiter Centered, Jupiter System III True Equinox and Equator of Date         | km<br>km/sec | E<br>E |
| 133-135 | Cartesian Position of Io, Jupiter Centered, Jupiter System III True Equinox and Equator of Date       | km           | E      |
| 136-138 | Cartesian Position of Europa, Jupiter Centered, Jupiter System III True Equinox and Equator of Date   | km           | E      |
| 139-141 | Cartesian Position of Ganymede, Jupiter Centered, Jupiter System III True Equinox and Equator of Date | km           | E      |
| 142-144 | Cartesian Position of Callisto, Jupiter Centered, Jupiter System III True Equinox and Equator of Date | km           | E      |
| 145-147 | Jupiter Latitude, System I Longitude and System III Longitude of S/C                                  | deg          | E      |
| 148-150 | Jupiter Latitude, System I Longitude and System III Longitude of Io                                   | deg          | E      |
| 151-153 | Jupiter Latitude, System I Longitude and System III Longitude of Europa                               | deg          | E      |

## Attachment D

## Navigation Data Block Format for Jupiter Encounter

| WORD    | DESCRIPTION   | UNITS | TYPE |
|---------|---|-------|------|
| 154-156 | Jupiter Latitude, System I Longitude and System III Longitude of Ganymede | deg   | E    |
| 157-159 | Jupiter Latitude, System I Longitude and System III Longitude of Callisto | deg   | E    |
| 160     | Range Earth - S/C   | km    | E    |
| 161     | Range Sun - S/C   | km    | E    |
| 162     | Range Sun - Earth   | km    | E    |
| 163     | Range Sun - Jupiter   | km    | E    |
| 164     | Range Jupiter - S/C   | km    | E    |
| 165     | Range Jupiter - Io  | km    | E    |
| 166     | Range Jupiter - Europa  | km    | E    |
| 167     | Range Jupiter - Ganymede  | km    | E    |
| 168     | Range Jupiter - Callisto  | km    | E    |
| 169     | Angle Earth - Sun - S/C   | deg   | E    |
| 170     | Angle Sun - S/C - Earth (S/C Cone Angle of Earth)                         | deg   | E    |
| 171     | Angle Sun - Earth - S/C   | deg   | E    |
| 172     | Angle Jupiter - Sun - S/C   | deg   | E    |
| 173     | Angle Sun - S/C - Jupiter (S/C Cone Angle of Jupiter)                     | deg   | E    |
| 174     | Angle Sun - Jupiter - S/C   | deg   | E    |
| 175     | S/C Clock Angle of Earth  | deg   | E    |

## Attachment D

## Navigation Data Block Format for Jupiter Encounter

| WORD    | DESCRIPTION  | UNITS        | TYPE   |
|---------|--|--------------|--------|
| 176     | S/C Clock Angle of Jupiter   | deg          | E      |
| 177-178 | S/C Clock and Cone Angles of Io  | deg          | E      |
| 179-180 | S/C Clock and Cone Angles of Europa  | deg          | E      |
| 181-182 | S/C Clock and Cone Angles of Ganymede  | deg          | E      |
| 183-184 | S/C Clock and Cone Angles of Callisto  | deg          | E      |
| 185-186 | Earth Right Ascension and Declination of S/C   | deg          | E      |
| 187-188 | Earth Right Ascension and Declination of Sun   | deg          | E      |
| 189-190 | Earth Right Ascension and Declination of Jupiter   | deg          | E      |
| 191-192 | Jupiter Right Ascension and Declination of S/C   | deg          | E      |
| 193-194 | Jupiter Right Ascension and Declination of Io  | deg          | E      |
| 195-196 | Jupiter Right Ascension and Declination of Europa  | deg          | E      |
| 197-198 | Jupiter Right Ascension and Declination of Ganymede  | deg          | E      |
| 199-200 | Jupiter Right Ascension and Declination of Callisto  | deg          | E      |
| 201-202 | Jupiter Right Ascension and Declination of Sun   | deg          | E      |
| 203-204 | Celestial Latitude and Longitude of S/C  | deg          | E      |
| 205-206 | Celestial Latitude and Longitude of Jupiter  | deg          | E      |
| 207-212 | Cartesian State of S/C, Jupiter Magnetic Dipole Centered,<br>Jupiter Magnetic Meridian and Equator of Date | km<br>km/sec | E<br>E |
| 213-218 | Cartesian State of Io, Jupiter Magnetic Dipole Centered,<br>Jupiter Magnetic Meridian and Equator of Date  | km<br>km/sec | E<br>E |



ATTACHMENT E

Navigation Data Block Format  
for Saturn Encounter

## Attachment E

## Navigation Data Block Format for Saturn Encounter

| WORD  | DESCRIPTION  | UNITS               | TYPE   |
|-------|--|---------------------|--------|
| 1     | GMT Year of Navigation Data Block  | years,<br>AD        | I      |
| 2     | GMT Day of Navigation Data Block   | day of<br>year      | I      |
| 3     | GMT Hour of Navigation Data Block  | hour of<br>day      | I      |
| 4     | GMT Minute of Navigation Data Block  | minute<br>of hour   | I      |
| 5     | GMT Second of Navigation Data Block  | second of<br>minute | I      |
| 6     | GMT Millisecond (Msec) of Navigation Data Block  | msec of<br>second   | I      |
| 7-12  | Cartesian State of S/C, Earth Centered, Earth True Equinox and Ecliptic of Date                  | km<br>km/sec        | E<br>E |
| 13-18 | Cartesian State of S/C, Sun Centered, Earth True Equinox and Ecliptic of Date                    | km<br>km/sec        | E<br>E |
| 19-24 | Cartesian State of Earth, Sun Centered, Earth True Equinox and Ecliptic of date                  | km<br>km/sec        | E<br>E |
| 25-30 | Cartesian State of Saturn, Sun Centered, Earth True Equinox and Ecliptic of Date                 | km<br>km/sec        | E<br>E |
| 31-36 | Cartesian State of S/C, Saturn Centered, Earth True Equinox and Ecliptic of Date                 | km<br>km/sec        | E<br>E |
| 37-42 | Cartesian State of Earth, Saturn Centered, Earth True Equinox and Ecliptic of Date               | km<br>km/sec        | E<br>E |
| 43-48 | Cartesian State of S/C, Titan Centered, Earth True Equinox and Ecliptic of Date                  | km<br>km/sec        | E<br>E |
| 49-54 | Cartesian State of Saturn, Titan Centered, Earth True Equinox and Ecliptic of Date               | km<br>km/sec        | E<br>E |
| 55-60 | Cartesian State of S/C, Saturn Centered, Saturn Mean Orbit and Prime Meridian in Sun Direction   | km<br>km/sec        | E<br>E |
| 61-66 | Cartesian State of Titan, Saturn Centered, Saturn Mean Orbit and Prime Meridian in Sun Direction | km<br>km/sec        | E<br>E |
| 67-72 | Cartesian State of S/C, Saturn Centered, Saturn True Equinox and Equator of Date                 | km<br>km/sec        | E<br>E |
| 73-75 | Cartesian Position of Titan, Saturn Centered, Saturn True Equinox and Equator of Date            | km                  | E      |

## Attachment E

## Navigation Data Block Format for Saturn Encounter

| WORD  | DESCRIPTION  | UNITS | TYPE |
|-------|--|-------|------|
| 76-77 | Saturn Latitude and Longitude of S/C                 | deg   | E    |
| 78-79 | Saturn Latitude and Longitude of Titan               | deg   | E    |
| 80    | Range Earth - S/C                                    | km    | E    |
| 81    | Range Sun - S/C                                      | km    | E    |
| 82    | Range Sun - Earth                                    | km    | E    |
| 83    | Range Sun - Saturn                                   | km    | E    |
| 84    | Range Saturn - S/C                                   | km    | E    |
| 85    | Range Saturn - Titan                                 | km    | E    |
| 86    | Angle Earth - Sun - S/C                              | deg   | E    |
| 87    | Angle Sun - S/C - Earth (S/C Cone Angle of Earth)    | deg   | E    |
| 88    | Angle Sun - Earth - S/C                              | deg   | E    |
| 89    | Angle Saturn - Sun - S/C                             | deg   | E    |
| 90    | Angle Sun - S/C - Saturn ( S/C Cone Angle of Saturn) | deg   | E    |
| 91    | Angle Sun - Saturn - S/C                             | deg   | E    |
| 92    | S/C Clock Angle of Earth                             | deg   | E    |
| 93    | S/C Clock Angle of Saturn                            | deg   | E    |
| 94-95 | S/C Clock and Cone Angles of Titan                   | deg   | E    |
| 96-97 | Earth Right Ascension and Declination of S/C         | deg   | E    |



ATTACHMENT F

Pointing Vector Data

Block Format

## Pointing Vector Data Block Format

| WORD  | DESCRIPTION  | UNITS             | TYPE |
|-------|--|-------------------|------|
| 1     | GMT Year of Pointing Vector Data Block   | years,<br>AD      | I    |
| 2     | GMT Day of Pointing Vector Data Block  | day of<br>year    | I    |
| 3     | GMT Hour of Pointing Vector Data Block   | hour of<br>day    | I    |
| 4     | GMT Minute of Pointing Vector Data Block   | minute<br>of hour | I    |
| 5     | GMT Second of Pointing Vector Data Block   | sec of<br>minute  | I    |
| 6     | GMT Millisecond (Msec) of Pointing Vector Data Block                                 | msec of<br>second | I    |
| 7     | FDSC MOD16 Count Value of Pointing Vector Data Block                                 | binary<br>counts  | I    |
| 8     | FDSC MOD60 Count Value of Pointing Vector Data Block                                 | binary<br>counts  | I    |
| 9     | FDSC Line Count Value of Pointing Vector Data Block                                  | binary<br>counts  | I    |
| 10    | Pitch Limit Cycle Angle  | deg               | E    |
| 11    | Yaw Limit Cycle Angle  | deg               | E    |
| 12    | Roll Limit Cycle Angle   | deg               | E    |
| 13-14 | S/C Clock and Cone Angles of S/C X-Axis  | deg               | E    |
| 15-17 | Cartesian Unit Vectors of the S/C X-Axis, Earth True Equinox<br>and Ecliptic of Date | dim               | E    |
| 18-19 | S/C Clock and Cone Angles of S/C Y-Axis  | deg               | E    |
| 20-22 | Cartesian Unit Vectors of the S/C Y-Axis, Earth True Equinox<br>and Ecliptic of Date | dim               | E    |
| 23-24 | S/C Clock and Cone Angles of S/C Z-Axis  | deg               | E    |
| 25-27 | Cartesian Unit Vectors of the S/C Z-Axis, Earth True Equinox<br>and Ecliptic of Date | dim               | E    |

## Pointing Vector Data Block Format

| WORD  | DESCRIPTION  | UNITS | TYPE |
|-------|--|-------|------|
| 28-29 | S/C Clock and Cone Angles of the CRS LET A Boresight   | deg   | E    |
| 30-32 | Cartesian Unit Vectors of the CRS LET A Boresight, Earth True Equinox and Ecliptic of Date   | dim   | E    |
| 33-34 | S/C Clock and Cone Angles of the CRS LET B Boresight   | deg   | E    |
| 35-37 | Cartesian Unit Vectors of the CRS LET B Boresight, Earth True Equinox and Ecliptic of Date   | dim   | E    |
| 38-39 | S/C Clock and Cone Angles of the CRS LET C Boresight   | deg   | E    |
| 40-42 | Cartesian Unit Vectors of the CRS LET C Boresight, Earth True Equinox and Ecliptic of Date   | dim   | E    |
| 43-44 | S/C Clock and Cone Angles of the CRS LET D Boresight   | deg   | E    |
| 45-47 | Cartesian Unit Vectors of the CRS LET D Boresight, Earth True Equinox and Ecliptic of Date   | dim   | E    |
| 48-49 | S/C Clock and Cone Angles of the CRS TET Boresight   | deg   | E    |
| 50-52 | Cartesian Unit Vectors of the CRS TET Boresight, Earth True Equinox and Ecliptic of Date     | dim   | E    |
| 53-54 | S/C Clock and Cone Angles of the CRS HET 1 Boresight   | deg   | E    |
| 55-57 | Cartesian Unit Vectors of the CRS HET 1 Boresight, Earth True Equinox and Ecliptic of Date   | dim   | E    |
| 58-59 | S/C Clock and Cone Angles of the CRS HET 21* Boresight                                       | deg   | E    |
| 60-62 | Cartesian Unit Vectors of the CRS HET 21 Boresight, Earth True Equinox and Ecliptic of Date  | dim   | E    |
| 63-64 | S/C Clock and Cone Angles of the CRS HET 22** Boresight                                      | deg   | E    |
| 65-67 | Cartesian Unit Vectors of the CRS HET 22 Boresight, Earth True Equinox and Ecliptic of Date  | dim   | E    |
| 68-69 | S/C Clock and Cone Angles of the LECP Axis of Rotation                                       | deg   | E    |
| 70-72 | Cartesian Unit Vectors of the LECP Axis of Rotation, Earth True Equinox and Ecliptic of Date | dim   | E    |

\*HET 2, Position 1

\*\*HET 2, Position 2

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Table B-12  
Fixed Instrument SEDR Format  
Uranus Navigation Block

Table B-12  
Fixed Instrument SEDR Format  
Uranus Encounter Navigation Block

| SEDR WORDS | DESCRIPTION   | UNITS          | TYPE | SOURCE  | DPTRAJ WORDS |
|------------|---|----------------|------|---------|--------------|
| 1          | SCE GMT Year of Navigation Data Block   | years, AD      | I    | SEDRGEN | **           |
| 2          | SCE GMT Day of Navigation Data Block  | day of year    | I    | SEDRGEN | **           |
| 3          | SCE GMT Hour of Navigation Data Block   | hour of day    | I    | SEDRGEN | **           |
| 4          | SCE GMT Minute of Navigation Data Block   | minute of hour | I    | SEDRGEN | **           |
| 5          | SCE GMT Second of Navigation Data Block   | second of min  | I    | SEDRGEN | **           |
| 6          | SCE GMT Millisecond (msec) of Navigation Data Block                                 | msec of second | I    | SEDRGEN | **           |
| 7-12       | Cartesian State of S/C, Earth Centered, Earth Mean Ecliptic and Equinox of 1950.0   | km<br>km/sec   | E    | DPTRAJ  | 35-40        |
| 13-18      | Cartesian State of S/C, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0     | km<br>km/sec   | E    | DPTRAJ  | 41-46        |
| 19-24      | Cartesian State of S/C, Uranus Centered, Earth Mean Ecliptic and Equinox of 1950.0  | km<br>km/sec   | E    | DPTRAJ  | 176-181      |
| 25-30      | Cartesian State of S/C, Miranda Centered, Earth Mean Ecliptic and Equinox of 1950.0 | km<br>km/sec   | E    | DPTRAJ  | 47-52        |
| 31-36      | Cartesian State of S/C, Ariel Centered, Earth Mean Ecliptic and Equinox of 1950.0   | km<br>km/sec   | E    | DPTRAJ  | 53-58        |

\* These WORDS refers to item numbers of the DPTRAJ SAVE tape file.  
\*\* See Appendix E; use algorithm one to obtain GMT from DPTRAJ time.

Table B-12  
Fixed Instrument SEDR Format  
Uranus Encounter Navigation Block

| SEDR WORDS | DESCRIPTION  | UNITS        | TYPE | SOURCE  | DPTRAJ WORDS     |
|------------|--|--------------|------|---------|------------------|
| 37-42      | Cartesian State of S/C, Umbriel Centered, Earth Mean Ecliptic and Equinox of 1950.0                | km<br>km/sec | E    | DPTRAJ  | 411-416          |
| 43-48      | Cartesian State of S/C, Titania Centered, Earth Mean Ecliptic and Equinox of 1950.0                | km<br>km/sec | E    | DPTRAJ  | 417-422          |
| 49-54      | Cartesian State of Earth, Sun Centered, Earth Mean Ecliptic Equinox of 1950.0                      | km<br>km/sec | E    | SEDRGEN | *                |
| 55-60      | Cartesian State of Uranus, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0                 | km<br>km/sec | E    | SEDRGEN | ***<br>(182-187) |
| 61-66      | Cartesian State of Earth, Uranus Centered, Earth Mean Ecliptic Equinox of 1950.0                   | km<br>km/sec | E    | DPTRAJ  | 260-265          |
| 67-72      | Cartesian State of Miranda, Uranus Centered, Earth Mean Ecliptic and Equinox of 1950.0             | km<br>km/sec | E    | DPTRAJ  | 188-193          |
| 73-78      | Cartesian State of Ariel, Uranus Centered, Earth Mean Ecliptic and Equinox of 1950.0               | km<br>km/sec | E    | DPTRAJ  | 194-199          |
| 79-84      | Cartesian State of Umbriel, Uranus Centered, Earth Mean Ecliptic and Equinox of 1950.0             | km<br>km/sec | E    | DPTRAJ  | 200-205          |
| 85-90      | Cartesian State of Titania, Uranus Centered, Earth Mean Ecliptic and Equinox of 1950.0             | km<br>km/sec | E    | DPTRAJ  | 206-211          |
| 91-96      | Cartesian State of S/C, Uranus Centered, Uranus Mean Orbit and Prime Meridian in Sun Direction     | km<br>km/sec | E    | SEDRGEN | **<br>(218-223)  |
| 97-102     | Cartesian State of Miranda, Uranus Centered, Uranus Mean Orbit and Prime Meridian in Sun Direction | km<br>km/sec | E    | SEDRGEN | **<br>(224-229)  |

\* See Appendix E, Table E-1 for algorithm and inputs to obtain these SEDR parameters.  
 \*\* See Appendix E, Table E-1 for the matrix of rotation to apply to these DPTRAJ inputs in parenthesis.  
 \*\*\* Reverse the signs of these DPTRAJ inputs in parenthesis.

Table B-11  
Fixed Instrument SEDR Format  
Uranus Encounter Navigation Block

| SEDR WORDS | DESCRIPTION  | UNITS        | TYPE | SOURCE            | DPTRAJ WORDS    |
|------------|--|--------------|------|-------------------|-----------------|
| 103-108    | Cartesian State of Ariel, Uranus Centered, Uranus Mean Orbit and Prime Meridian in Sun Direction   | km<br>km/sec | E    | SEDRGEN           | **<br>(230-235) |
| 109-114    | Cartesian State of Umbriel, Uranus Centered, Uranus Mean Orbit and Prime Meridian in Sun Direction | km<br>km/sec | E    | SEDRGEN           | **<br>(236-241) |
| 115-120    | Cartesian State of Titania, Uranus Centered, Uranus Mean Orbit and Prime Meridian in Sun Direction | km<br>km/sec | E    | SEDRGEN           | **<br>(242-247) |
| 121-126    | Cartesian State of S/C, Uranus Centered, Uranus True Prime Meridian and Equator of Date            | km<br>km/sec | E    | DPTRAJ            | 376-381         |
| 127-129    | Cartesian Position of Miranda, Uranus Centered, Uranus True Prime Meridian and Equator of Date     | km           | E    | SEDRGEN           | **<br>(382-384) |
| 130-132    | Cartesian Position of Ariel, Uranus Centered, Uranus True Prime Meridian and Equator of Date       | km           | E    | SEDRGEN           | **<br>(385-387) |
| 133-135    | Cartesian Position of Umbriel, Uranus Centered, Uranus True Prime Meridian and Equator of Date     | km           | E    | SEDRGEN           | **<br>(388-390) |
| 136-138    | Cartesian Position of Titania, Uranus Centered, Uranus True Prime Meridian and Equator of Date     | km           | E    | SEDRGEN           | **<br>(391-393) |
| 139-140    | Uranus Latitude*, Longitude of S/C   | deg          | E    | DPTRAJ<br>SEDRGEN | 395<br>***      |
| 141-142    | Uranus Latitude*, Longitude of Miranda   | deg          | E    | DPTRAJ<br>SEDRGEN | 402<br>***      |
| 143-144    | Uranus Latitude*, Longitude of Ariel   | deg          | E    | DPTRAJ<br>SEDRGEN | 404<br>***      |

\* Planetocentric latitude

\*\* See Appendix E, Table E-1 for the matrix of rotation to apply to these DPTRAJ inputs in parenthesis.

\*\*\* See Appendix E, Table E-1 for algorithm and inputs to obtain the longitude angle.

Table B-12  
Fixed Instrument SEDR Format  
Uranus Encounter Navigation Block

| SEDR WORDS | DESCRIPTION                            | UNITS | TYPE | SOURCE            | DPTRAJ WORDS |
|------------|--|-------|------|-------------------|--------------|
| 145-146    | Uranus Latitude*, Longitude of Umbriel | deg   | E    | DPTRAJ<br>SEDRGEN | 406<br>***   |
| 147-148    | Uranus Latitude*, Longitude of Titania | deg   | E    | DPTRAJ<br>SEDRGEN | 408<br>***   |
| 149        | Range Earth - S/C                      | km    | E    | DPTRAJ            | 12           |
| 150        | Range Sun - S/C                        | km    | E    | DPTRAJ            | 21           |
| 151        | Range Sun - Earth                      | km    | E    | DPTRAJ            | 15           |
| 152        | Range Sun - Uranus                     | km    | E    | DPTRAJ            | 212          |
| 153        | Range Uranus - S/C                     | km    | E    | DPTRAJ            | 213          |
| 154        | Range Uranus - Miranda                 | km    | E    | DPTRAJ            | 214          |
| 155        | Range Uranus - Ariel                   | km    | E    | DPTRAJ            | 215          |
| 156        | Range Uranus - Umbriel                 | km    | E    | DPTRAJ            | 216          |
| 157        | Range Uranus - Titania                 | km    | E    | DPTRAJ            | 217          |

\* Planetocentric latitude

\*\*\* See Appendix E, Table E-1 for algorithm and inputs to obtain the longitude angle.

Table B-12  
Fixed Instrument SEDR Format  
Uranus Encounter Navigation Block

| SEDR WORDS | DESCRIPTION   | UNITS | TYPE | SOURCE | DPTRAJ WORDS |
|------------|---|-------|------|--------|--------------|
| 158        | Angle Earth - Sun - S/C                                   | deg   | E    | DPTRAJ | 88           |
| 159        | Angle Sun - S/C - Earth (Celestial Cone Angle of Earth)   | deg   | E    | DPTRAJ | 80           |
| 160        | Angle Sun - Earth - S/C                                   | deg   | E    | DPTRAJ | 87           |
| 161        | Angle Uranus - Sun - S/C                                  | deg   | E    | DPTRAJ | 256          |
| 162        | Angle Sun - S/C - Uranus (Celestial Cone Angle of Uranus) | deg   | E    | DPTRAJ | 257          |
| 163        | Angle Sun - Uranus - S/C                                  | deg   | E    | DPTRAJ | 258          |
| 164        | Celestial Clock Angle of Earth                            | deg   | E    | DPTRAJ | 94           |
| 165        | Celestial Clock Angle of Uranus                           | deg   | E    | DPTRAJ | 259          |
| 166-167    | Celestial Clock and Cone Angles of Miranda                | deg   | E    | DPTRAJ | 96,89        |
| 168-169    | Celestial Clock and Cone Angles of Ariel                  | deg   | E    | DPTRAJ | 98,90        |
| 170-171    | Celestial Clock and Cone Angles of Umbriel                | deg   | E    | DPTRAJ | 423-424      |

Table B-12  
 Fixed Instrument SEDR Format  
 Uranus Encounter Navigation Block

| SEDR WORDS | DESCRIPTION  | UNITS | TYPE | SOURCE | DPTRAJ WORDS |
|------------|--|-------|------|--------|--------------|
| 172-173    | Celestial Clock and Cone Angles of Titania   | deg   | E    | DPTRAJ | 425-426      |
| 174-175    | Right Ascension and Declination of S/C, Earth Centered, Earth Mean Equator and Equinox of 1950.0     | deg   | E    | DPTRAJ | 249-250      |
| 176-177    | Right Ascension and Declination of Sun, Earth Centered, Earth Mean Equator and Equinox of 1950.0     | deg   | E    | DPTRAJ | 251-252      |
| 178-179    | Right Ascension and Declination of Uranus, Earth Centered, Earth Mean Equator and Equinox of 1950.0  | deg   | E    | DPTRAJ | 253-254      |
| 180-181    | Right Ascension and Declination of S/C, Uranus Centered, Uranus True Equinox and Equator of Date     | deg   | E    | DPTRAJ | 397-398      |
| 182-183    | Right Ascension and Declination of Sun, Uranus Centered, Uranus True Equinox and Equator of Date     | deg   | E    | DPTRAJ | 399-400      |
| 184-185    | Right Ascension and Declination of Miranda, Uranus Centered, Uranus True Equinox and Equator of Date | deg   | E    | DPTRAJ | 401-402      |
| 186-187    | Right Ascension and Declination of Ariel, Uranus Centered, Uranus True Equinox and Equator of Date   | deg   | E    | DPTRAJ | 403-404      |
| 188-189    | Right Ascension and Declination of Umbriel, Uranus Centered, Uranus True Equinox and Equator of Date | deg   | E    | DPTRAJ | 405-406      |
| 190-191    | Right Ascension and Declination of Titania, Uranus Centered, Uranus True Equinox and Equator of Date | deg   | E    | DPTRAJ | 407-408      |
| 192-193    | Celestial Latitude* and Longitude of S/C, Sun Centered, Earth True Equinox and Ecliptic of Date      | deg   | E    | DPTRAJ | 24-25        |

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\* Planetocentric latitude

Table B-12  
 Fixed Instrument SEDR Format  
 Uranus Encounter Navigation Block

| SEDR WORDS | DESCRIPTION   | UNITS | TYPE | SOURCE | DPTRAJ WORDS |
|------------|---|-------|------|--------|--------------|
| 194-195    | Celestial Latitude* and Longitude of Earth, Sun Centered Earth True Equinox and Ecliptic of Date  | deg   | E    | DPTRAJ | 26-27        |
| 196-197    | Celestial Latitude* and Longitude of Uranus, Sun Centered Earth True Equinox and Ecliptic of Date | deg   | E    | DPTRAJ | 409-410      |
| 198        | Time To (-) / From (+) Uranus Periapsis Passage   | sec   | E    | DPTRAJ | 255          |
| 199-252    | Spares  |       |      |        |              |
|            |   |       |      |        |              |
|            |   |       |      |        |              |
|            |   |       |      |        |              |
|            |   |       |      |        |              |
|            |   |       |      |        |              |
|            |   |       |      |        |              |
|            |   |       |      |        |              |
|            |   |       |      |        |              |
|            |   |       |      |        |              |
|            |   |       |      |        |              |
|            |   |       |      |        |              |
|            |   |       |      |        |              |

\* Planetocentric latitude

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DETECTOR RADII: R1= 1.596 R2= 1.596  
SEPARATION: D= 5.740  
RADIUS OF CURVATURE: RC= 6.160  
NO. OF EVENTS 10000

| PATHL | NACC | PATHL | NACC | PATHL | NACC | PATHL | NACC |
|-------|------|-------|------|-------|------|-------|------|
| 0.998 | 0    | 1.000 | 624  | 1.002 | 570  | 1.004 | 549  |
| 1.006 | 606  | 1.008 | 613  | 1.010 | 571  | 1.012 | 554  |
| 1.014 | 601  | 1.016 | 586  | 1.018 | 618  | 1.020 | 581  |
| 1.022 | 508  | 1.024 | 541  | 1.026 | 527  | 1.028 | 529  |
| 1.030 | 558  | 1.032 | 448  | 1.034 | 211  | 1.036 | 0    |

NO. OF ACCEPTED EVENTS= 9795  
MAX. THETA= 15.0  
MEAN PATHLENGTH= 1.01590  
SIGMA= 0.00994  
GEOM. FACTOR= 1.682  
CALC. GEOM. FACTOR 1.691

DETECTOR RADII: R1= 1.000 R2= 1.000  
SEPARATION: D= 4.000  
RADIUS OF CURVATURE: RC= 4.600  
NO. OF EVENTS 10000

| PATHL | NACC | PATHL | NACC | PATHL | NACC | PATHL | NACC |
|-------|------|-------|------|-------|------|-------|------|
| 0.998 | 0    | 1.000 | 706  | 1.002 | 648  | 1.004 | 658  |
| 1.006 | 710  | 1.008 | 663  | 1.010 | 639  | 1.012 | 697  |
| 1.014 | 679  | 1.016 | 707  | 1.018 | 629  | 1.020 | 618  |
| 1.022 | 608  | 1.024 | 591  | 1.026 | 525  | 1.028 | 282  |
| 1.030 | 37   | 1.032 | 0    | 1.034 | 0    | 1.036 | 0    |

NO. OF ACCEPTED EVENTS= 9397  
MAX. THETA= 14.0  
MEAN PATHLENGTH= 1.01309  
SIGMA= 0.00829  
GEOM. FACTOR= 0.550  
CALC. GEOM. FACTOR 0.550

DETECTOR RADII: R1= 1.000 R2= 1.000  
SEPARATION: D= 4.000  
RADIUS OF CURVATURE: RC= 4.700  
NO. OF EVENTS 10000

| PATHL | NACC | PATHL | NACC | PATHL | NACC | PATHL | NACC |
|-------|------|-------|------|-------|------|-------|------|
| 0.998 | 0    | 1.000 | 681  | 1.002 | 628  | 1.004 | 625  |
| 1.006 | 682  | 1.008 | 629  | 1.010 | 632  | 1.012 | 649  |
| 1.014 | 678  | 1.016 | 664  | 1.018 | 634  | 1.020 | 588  |
| 1.022 | 578  | 1.024 | 544  | 1.026 | 451  | 1.028 | 288  |
| 1.030 | 102  | 1.032 | 0    | 1.034 | 0    | 1.036 | 0    |

NO. OF ACCEPTED EVENTS= 9053  
MAX. THETA= 14.3  
MEAN PATHLENGTH= 1.01313  
SIGMA= 0.00835  
GEOM. FACTOR= 0.550  
CALC. GEOM. FACTOR 0.550

DETECTOR RADII: R1= 1.000 R2= 1.000  
SEPARATION: D= 4.000  
RADIUS OF CURVATURE: RC= 4.800  
NO. OF EVENTS 10000

| PATHL | NACC | PATHL | NACC | PATHL | NACC | PATHL | NACC |
|-------|------|-------|------|-------|------|-------|------|
| 0.998 | 0    | 1.000 | 661  | 1.002 | 611  | 1.004 | 599  |
| 1.006 | 652  | 1.008 | 608  | 1.010 | 622  | 1.012 | 615  |
| 1.014 | 650  | 1.016 | 618  | 1.018 | 656  | 1.020 | 552  |
| 1.022 | 578  | 1.024 | 494  | 1.026 | 398  | 1.028 | 312  |
| 1.030 | 138  | 1.032 | 17   | 1.034 | 0    | 1.036 | 0    |

NO. OF ACCEPTED EVENTS= 8781  
MAX. THETA= 14.5  
MEAN PATHLENGTH= 1.01323  
SIGMA= 0.00845  
GEOM. FACTOR= 0.552  
CALC. GEOM. FACTOR 0.550

DETECTOR RADII: R1= 1.000 R2= 1.000  
SEPARATION: D= 4.000  
RADIUS OF CURVATURE: RC= 5.000  
NO. OF EVENTS 10000

| PATHL | NACC | PATHL | NACC | PATHL | NACC | PATHL | NACC |
|-------|------|-------|------|-------|------|-------|------|
| 0.998 | 0    | 1.000 | 624  | 1.002 | 569  | 1.004 | 548  |
| 1.006 | 601  | 1.008 | 617  | 1.010 | 567  | 1.012 | 555  |
| 1.014 | 599  | 1.016 | 587  | 1.018 | 619  | 1.020 | 574  |
| 1.022 | 463  | 1.024 | 432  | 1.026 | 366  | 1.028 | 263  |
| 1.030 | 184  | 1.032 | 80   | 1.034 | 11   | 1.036 | 0    |

NO. OF ACCEPTED EVENTS= 8259  
MAX. THETA= 15.0  
MEAN PATHLENGTH= 1.01338  
SIGMA= 0.00863  
GEOM. FACTOR= 0.554  
CALC. GEOM. FACTOR 0.550

DETECTOR: MJS B END UNIFORM THKNSS FOR PARALLEL BEAM

DETECTOR RADII: R1= 1.596 R2= 1.596  
SEPARATION: D= 5.740  
RADIUS OF CURVATURE: RC= 6.160  
NO. OF EVENTS 10000

THKNSS RADIUS ANGLE  
0.200 0.000 0.000

| PATHL | NACC | PATHL | NACC | PATHL | NACC | PATHL | NACC |
|-------|------|-------|------|-------|------|-------|------|
| 0.966 | 7    | 0.968 | 36   | 0.970 | 78   | 0.972 | 114  |
| 0.974 | 127  | 0.976 | 181  | 0.978 | 205  | 0.980 | 262  |
| 0.982 | 279  | 0.984 | 322  | 0.986 | 344  | 0.988 | 387  |
| 0.990 | 416  | 0.992 | 478  | 0.994 | 502  | 0.996 | 553  |
| 0.998 | 574  | 1.000 | 546  | 1.002 | 541  | 1.004 | 512  |
| 1.006 | 485  | 1.008 | 412  | 1.010 | 387  | 1.012 | 345  |
| 1.014 | 324  | 1.016 | 278  | 1.018 | 231  | 1.020 | 222  |
| 1.022 | 178  | 1.024 | 146  | 1.026 | 140  | 1.028 | 92   |
| 1.030 | 58   | 1.032 | 37   | 1.034 | 4    | 1.036 | 0    |

NO. OF ACCEPTED EVENTS= 9803  
MAX. THETA= 15.0  
MEAN PATHLENGTH= 0.99932  
SIGMA= 0.01379  
GEOM. FACTOR= 1.683  
CALC. GEOM. FACTOR 1.691

TEST

DETECTOR: ORTEC SER. 15-8364

DETECTOR RADII: R1= 1.596 R2= 1.596  
SEPARATION: D= 5.740  
RADIUS OF CURVATURE: RC= 6.160  
NO. OF EVENTS 10000

| THKNSS | RADIUS | ANGLE |
|--------|--------|-------|
| 1.000  | 0.000  | 0.000 |
| 1.100  | 1.596  | 0.000 |
| 1.100  | 1.596  | 1.570 |
| 1.100  | 1.596  | 3.141 |
| 1.100  | 1.596  | 4.712 |

| PATHL | NACC | PATHL | NACC | PATHL | NACC | PATHL | NACC |
|-------|------|-------|------|-------|------|-------|------|
| 0.998 | 0    | 1.000 | 0    | 1.002 | 0    | 1.004 | 1    |
| 1.006 | 2    | 1.008 | 9    | 1.010 | 5    | 1.012 | 4    |
| 1.014 | 17   | 1.016 | 18   | 1.018 | 19   | 1.020 | 24   |
| 1.022 | 30   | 1.024 | 33   | 1.026 | 47   | 1.028 | 48   |
| 1.030 | 48   | 1.032 | 59   | 1.034 | 67   | 1.036 | 80   |
| 1.038 | 82   | 1.040 | 112  | 1.042 | 93   | 1.044 | 124  |
| 1.046 | 112  | 1.048 | 118  | 1.050 | 133  | 1.052 | 124  |
| 1.054 | 143  | 1.056 | 153  | 1.058 | 143  | 1.060 | 167  |
| 1.062 | 177  | 1.064 | 194  | 1.066 | 184  | 1.068 | 206  |
| 1.070 | 188  | 1.072 | 231  | 1.074 | 215  | 1.076 | 222  |
| 1.078 | 243  | 1.080 | 246  | 1.082 | 238  | 1.084 | 278  |
| 1.086 | 255  | 1.088 | 277  | 1.090 | 276  | 1.092 | 283  |
| 1.094 | 330  | 1.096 | 307  | 1.098 | 302  | 1.100 | 328  |
| 1.102 | 297  | 1.104 | 272  | 1.106 | 302  | 1.108 | 250  |
| 1.110 | 236  | 1.112 | 216  | 1.114 | 193  | 1.116 | 167  |
| 1.118 | 166  | 1.120 | 134  | 1.122 | 128  | 1.124 | 131  |
| 1.126 | 81   | 1.128 | 81   | 1.130 | 54   | 1.132 | 44   |
| 1.134 | 33   | 1.136 | 14   | 1.138 | 2    | 1.140 | 0    |

NO. OF ACCEPTED EVENTS= 9796  
MAX. THETA= 15.0  
MEAN PATHLENGTH= 1.08369  
SIGMA= 0.02609  
GEOM. FACTOR= 1.682  
CALC. GEOM. FACTOR 1.691

TEST

DETECTOR: ~~DR15C SER. 15-836E~~

DETECTOR RADII: R1= 1.596 R2= 1.596

SEPARATION: D= 5.740

RADIUS OF CURVATURE: RC= 6.160

NO. OF EVENTS 10000

| THKNSS | RADIUS | ANGLE |
|--------|--------|-------|
| 1.000  | 0.000  | 0.000 |
| 1.050  | 1.596  | 0.000 |
| 1.050  | 1.596  | 1.570 |
| 1.050  | 1.596  | 3.141 |
| 1.050  | 1.596  | 4.712 |

| PATHL | NACC | PATHL | NACC | PATHL | NACC | PATHL | NACC |
|-------|------|-------|------|-------|------|-------|------|
| 0.998 | 0    | 1.000 | 1    | 1.002 | 3    | 1.004 | 6    |
| 1.006 | 7    | 1.008 | 14   | 1.010 | 27   | 1.012 | 35   |
| 1.014 | 47   | 1.016 | 66   | 1.018 | 87   | 1.020 | 104  |
| 1.022 | 124  | 1.024 | 134  | 1.026 | 167  | 1.028 | 213  |
| 1.030 | 211  | 1.032 | 256  | 1.034 | 291  | 1.036 | 304  |
| 1.038 | 327  | 1.040 | 377  | 1.042 | 394  | 1.044 | 394  |
| 1.046 | 441  | 1.048 | 495  | 1.050 | 508  | 1.052 | 469  |
| 1.054 | 472  | 1.056 | 423  | 1.058 | 400  | 1.060 | 398  |
| 1.062 | 376  | 1.064 | 359  | 1.066 | 331  | 1.068 | 313  |
| 1.070 | 259  | 1.072 | 218  | 1.074 | 213  | 1.076 | 199  |
| 1.078 | 147  | 1.080 | 96   | 1.082 | 62   | 1.084 | 32   |
| 1.086 | 6    | 1.088 | 0    | 1.090 | 0    | 1.092 | 0    |

NO. OF ACCEPTED EVENTS= 9806

MAX. THETA= 15.0

MEAN PATHLENGTH= 1.05006

SIGMA= 0.01588

GEOM. FACTOR= 1.684

CALC. GEOM. FACTOR 1.691

DETECTOR: ORTEC SER. 15-313B

DETECTOR RADII: R1= 1.596 R2= 1.596

SEPARATION: D= 5.740

RADIUS OF CURVATURE: RC= 6.160

NO. OF EVENTS 10000

| THKNSS  | RADIUS | ANGLE |
|---------|--------|-------|
| 149.000 | 0.000  | 0.000 |
| 150.100 | 0.800  | 0.000 |
| 150.500 | 1.300  | 0.000 |
| 147.800 | 0.800  | 3.141 |
| 145.200 | 1.300  | 3.141 |

| PATHL | NACC | PATHL | NACC | PATHL | NACC | PATHL | NACC |
|-------|------|-------|------|-------|------|-------|------|
| 0.958 | 0    | 0.960 | 0    | 0.962 | 0    | 0.964 | 7    |
| 0.966 | 37   | 0.968 | 45   | 0.970 | 69   | 0.972 | 91   |
| 0.974 | 113  | 0.976 | 121  | 0.978 | 120  | 0.980 | 108  |
| 0.982 | 124  | 0.984 | 122  | 0.986 | 119  | 0.988 | 120  |
| 0.990 | 128  | 0.992 | 146  | 0.994 | 152  | 0.996 | 156  |
| 0.998 | 165  | 1.000 | 160  | 1.002 | 164  | 1.004 | 168  |
| 1.006 | 240  | 1.008 | 306  | 1.010 | 412  | 1.012 | 499  |
| 1.014 | 475  | 1.016 | 472  | 1.018 | 457  | 1.020 | 431  |
| 1.022 | 470  | 1.024 | 456  | 1.026 | 404  | 1.028 | 374  |
| 1.030 | 381  | 1.032 | 380  | 1.034 | 340  | 1.036 | 334  |
| 1.038 | 319  | 1.040 | 267  | 1.042 | 192  | 1.044 | 119  |
| 1.046 | 28   | 1.048 | 2    | 1.050 | 2    | 1.052 | 0    |

NO. OF ACCEPTED EVENTS= 9795

MAX. THETA= 15.0

MEAN PATHLENGTH= 1.01462

SIGMA= 0.01848

GEOM. FACTOR= 1.682

CALC. GEOM. FACTOR 1.691

DETECTOR: ORTEC SER. 15-313C

DETECTOR RADII: R1= 1.596 R2= 1.596

SEPARATION: D= 5.740

RADIUS OF CURVATURE: RC= 6.160

NO. OF EVENTS 10000

| THKNESS | RADIUS | ANGLE |
|---------|--------|-------|
| 145.700 | 0.000  | 0.000 |
| 144.800 | 0.800  | 0.000 |
| 144.390 | 1.300  | 0.000 |
| 145.690 | 0.800  | 3.141 |
| 144.700 | 1.300  | 3.141 |

| PATHL | NACC | PATHL | NACC | PATHL | NACC | PATHL | NACC |
|-------|------|-------|------|-------|------|-------|------|
| 0.982 | 0    | 0.984 | 0    | 0.986 | 0    | 0.988 | 8    |
| 0.990 | 148  | 0.992 | 320  | 0.994 | 429  | 0.996 | 526  |
| 0.998 | 519  | 1.000 | 504  | 1.002 | 540  | 1.004 | 570  |
| 1.006 | 585  | 1.008 | 609  | 1.010 | 544  | 1.012 | 526  |
| 1.014 | 593  | 1.016 | 537  | 1.018 | 538  | 1.020 | 562  |
| 1.022 | 497  | 1.024 | 408  | 1.026 | 272  | 1.028 | 196  |
| 1.030 | 125  | 1.032 | 83   | 1.034 | 74   | 1.036 | 38   |
| 1.038 | 30   | 1.040 | 19   | 1.042 | 10   | 1.044 | 7    |
| 1.046 | 3    | 1.048 | 0    | 1.050 | 0    | 1.052 | 0    |

NO. OF ACCEPTED EVENTS= 9820

MAX. THETA= 15.0

MEAN PATHLENGTH= 1.00996

SIGMA= 0.01105

GEOM. FACTOR= 1.686

CALC. GEOM. FACTOR 1.691

DETECTOR: ORTEC SER. 15-7080

DETECTOR RADII: R1= 1.596 R2= 1.596

SEPARATION: D= 5.740

RADIUS OF CURVATURE: RC= 6.160

NO. OF EVENTS 10000

| THKNSS  | RADIUS | ANGLE |
|---------|--------|-------|
| 152.050 | 0.000  | 0.000 |
| 156.900 | 0.800  | 0.000 |
| 160.690 | 1.300  | 0.000 |
| 157.100 | 0.800  | 3.141 |
| 160.700 | 1.300  | 3.141 |

| PATHL | NACC | PATHL | NACC | PATHL | NACC | PATHL | NACC |
|-------|------|-------|------|-------|------|-------|------|
| 0.998 | 1    | 1.000 | 4    | 1.002 | 5    | 1.004 | 12   |
| 1.006 | 10   | 1.008 | 17   | 1.010 | 23   | 1.012 | 31   |
| 1.014 | 37   | 1.016 | 60   | 1.018 | 59   | 1.020 | 58   |
| 1.022 | 82   | 1.024 | 84   | 1.026 | 99   | 1.028 | 115  |
| 1.030 | 113  | 1.032 | 141  | 1.034 | 185  | 1.036 | 171  |
| 1.038 | 196  | 1.040 | 171  | 1.042 | 244  | 1.044 | 222  |
| 1.046 | 255  | 1.048 | 274  | 1.050 | 283  | 1.052 | 296  |
| 1.054 | 286  | 1.056 | 298  | 1.058 | 315  | 1.060 | 330  |
| 1.062 | 345  | 1.064 | 350  | 1.066 | 392  | 1.068 | 335  |
| 1.070 | 343  | 1.072 | 352  | 1.074 | 355  | 1.076 | 338  |
| 1.078 | 312  | 1.080 | 267  | 1.082 | 260  | 1.084 | 226  |
| 1.086 | 220  | 1.088 | 206  | 1.090 | 201  | 1.092 | 176  |
| 1.094 | 152  | 1.096 | 140  | 1.098 | 113  | 1.100 | 80   |
| 1.102 | 67   | 1.104 | 43   | 1.106 | 20   | 1.108 | 6    |

NO. OF ACCEPTED EVENTS= 9776

MAX. THETA= 15.0

MEAN PATHLENGTH= 1.06193

SIGMA= 0.02098

GEOM. FACTOR= 1.678

CALC. GEOM. FACTOR 1.691

DETECTOR: ORTEC SER. 15-811B

DETECTOR RADII: R1= 1.596 R2= 1.596

SEPARATION: D= 5.740

RADIUS OF CURVATURE: RC= 6.160

NO. OF EVENTS 10000

| THKNSS  | RADIUS | ANGLE |
|---------|--------|-------|
| 141.340 | 0.000  | 0.000 |
| 143.110 | 0.800  | 0.000 |
| 145.680 | 1.300  | 0.000 |
| 144.030 | 0.800  | 3.141 |
| 147.480 | 1.300  | 3.141 |

| PATHL | NACC | PATHL | NACC | PATHL | NACC | PATHL | NACC |
|-------|------|-------|------|-------|------|-------|------|
| 0.982 | 0    | 0.984 | 1    | 0.986 | 1    | 0.988 | 2    |
| 0.990 | 1    | 0.992 | 2    | 0.994 | 8    | 0.996 | 17   |
| 0.998 | 13   | 1.000 | 28   | 1.002 | 37   | 1.004 | 49   |
| 1.006 | 43   | 1.008 | 81   | 1.010 | 101  | 1.012 | 120  |
| 1.014 | 149  | 1.016 | 196  | 1.018 | 250  | 1.020 | 301  |
| 1.022 | 280  | 1.024 | 320  | 1.026 | 312  | 1.028 | 361  |
| 1.030 | 381  | 1.032 | 375  | 1.034 | 369  | 1.036 | 385  |
| 1.038 | 403  | 1.040 | 447  | 1.042 | 409  | 1.044 | 377  |
| 1.046 | 376  | 1.048 | 343  | 1.050 | 320  | 1.052 | 314  |
| 1.054 | 280  | 1.056 | 280  | 1.058 | 241  | 1.060 | 249  |
| 1.062 | 222  | 1.064 | 183  | 1.066 | 188  | 1.068 | 159  |
| 1.070 | 129  | 1.072 | 134  | 1.074 | 94   | 1.076 | 102  |
| 1.078 | 99   | 1.080 | 71   | 1.082 | 54   | 1.084 | 46   |
| 1.086 | 39   | 1.088 | 25   | 1.090 | 15   | 1.092 | 11   |
| 1.094 | 2    | 1.096 | 0    | 1.098 | 0    | 1.100 | 0    |

NO. OF ACCEPTED EVENTS= 9795

MAX. THETA= 15.0

MEAN PATHLENGTH= 1.04142

SIGMA= 0.01867

GEOM. FACTOR= 1.682

CALC. GEOM. FACTOR 1.691

DETECTOR: ORTEC SER. 15-836E

DETECTOR RADII: R1= 1.596 R2= 1.596  
SEPARATION: D= 5.740  
RADIUS OF CURVATURE: RC= 6.160  
NO. OF EVENTS 10000

| THKNSS  | RADIUS | ANGLE |
|---------|--------|-------|
| 147.820 | 0.000  | 0.000 |
| 151.100 | 1.300  | 0.000 |
| 153.270 | 1.300  | 1.570 |
| 153.750 | 1.300  | 3.141 |
| 151.910 | 1.300  | 4.712 |

| PATHL | NACC | PATHL | NACC | PATHL | NACC | PATHL | NACC |
|-------|------|-------|------|-------|------|-------|------|
| 0.998 | 0    | 1.000 | 0    | 1.002 | 2    | 1.004 | 13   |
| 1.006 | 19   | 1.008 | 43   | 1.010 | 50   | 1.012 | 89   |
| 1.014 | 94   | 1.016 | 124  | 1.018 | 168  | 1.020 | 180  |
| 1.022 | 262  | 1.024 | 283  | 1.026 | 316  | 1.028 | 361  |
| 1.030 | 391  | 1.032 | 412  | 1.034 | 411  | 1.036 | 452  |
| 1.038 | 451  | 1.040 | 444  | 1.042 | 451  | 1.044 | 460  |
| 1.046 | 463  | 1.048 | 499  | 1.050 | 431  | 1.052 | 417  |
| 1.054 | 424  | 1.056 | 342  | 1.058 | 317  | 1.060 | 256  |
| 1.062 | 224  | 1.064 | 187  | 1.066 | 177  | 1.068 | 134  |
| 1.070 | 137  | 1.072 | 94   | 1.074 | 78   | 1.076 | 56   |
| 1.078 | 49   | 1.080 | 25   | 1.082 | 10   | 1.084 | 4    |

NO. OF ACCEPTED EVENTS= 9800  
MAX. THETA= 15.0  
MEAN PATHLENGTH= 1.04249  
SIGMA= 0.01527  
GEOM. FACTOR= 1.683  
CALC. GEOM. FACTOR 1.691

DETECTOR: ORTEC SER. 15-099A

DETECTOR RADII: R1= 1.596 R2= 1.596  
SEPARATION: D= 5.740  
RADIUS OF CURVATURE: RC= 6.160  
NO. OF EVENTS 10000

| THKNNESS | RADIUS | ANGLE |
|----------|--------|-------|
| 145.300  | 0.000  | 0.000 |
| 144.650  | 1.300  | 0.000 |
| 145.240  | 1.300  | 1.570 |
| 141.770  | 1.300  | 3.141 |
| 141.380  | 1.300  | 4.712 |

| PATHL | NACC | PATHL | NACC | PATHL | NACC | PATHL | NACC |
|-------|------|-------|------|-------|------|-------|------|
| 0.966 | 0    | 0.968 | 20   | 0.970 | 52   | 0.972 | 79   |
| 0.974 | 127  | 0.976 | 142  | 0.978 | 178  | 0.980 | 183  |
| 0.982 | 181  | 0.984 | 205  | 0.986 | 241  | 0.988 | 278  |
| 0.990 | 280  | 0.992 | 294  | 0.994 | 266  | 0.996 | 453  |
| 0.998 | 445  | 1.000 | 517  | 1.002 | 557  | 1.004 | 518  |
| 1.006 | 454  | 1.008 | 475  | 1.010 | 448  | 1.012 | 400  |
| 1.014 | 407  | 1.016 | 356  | 1.018 | 351  | 1.020 | 344  |
| 1.022 | 297  | 1.024 | 316  | 1.026 | 275  | 1.028 | 267  |
| 1.030 | 210  | 1.032 | 134  | 1.034 | 45   | 1.036 | 0    |

NO. OF ACCEPTED EVENTS= 9795

MAX. THETA= 15.0

MEAN PATHLENGTH= 1.00439

SIGMA= 0.01503

GEOM. FACTOR= 1.682

CALC. GEOM. FACTOR 1.691

DETECTOR: ORTEC SER. 15-849E

DETECTOR RADII: R1= 1.596 R2= 1.596

SEPARATION: D= 5.740

RADIUS OF CURVATURE: RC= 6.160

NO. OF EVENTS 10000

| THKNNESS | RADIUS | ANGLE |
|----------|--------|-------|
| 148.520  | 0.000  | 0.000 |
| 150.810  | 1.300  | 0.000 |
| 150.720  | 1.300  | 1.570 |
| 152.340  | 1.300  | 3.141 |
| 152.660  | 1.300  | 4.712 |

| PATHL | NACC | PATHL | NACC | PATHL | NACC | PATHL | NACC |
|-------|------|-------|------|-------|------|-------|------|
| 0.998 | 0    | 1.000 | 1    | 1.002 | 13   | 1.004 | 38   |
| 1.006 | 53   | 1.008 | 86   | 1.010 | 137  | 1.012 | 213  |
| 1.014 | 279  | 1.016 | 345  | 1.018 | 377  | 1.020 | 407  |
| 1.022 | 420  | 1.024 | 466  | 1.026 | 499  | 1.028 | 523  |
| 1.030 | 518  | 1.032 | 537  | 1.034 | 566  | 1.036 | 565  |
| 1.038 | 523  | 1.040 | 478  | 1.042 | 450  | 1.044 | 426  |
| 1.046 | 372  | 1.048 | 322  | 1.050 | 262  | 1.052 | 207  |
| 1.054 | 171  | 1.056 | 159  | 1.058 | 137  | 1.060 | 103  |
| 1.062 | 74   | 1.064 | 37   | 1.066 | 32   | 1.068 | 10   |
| 1.070 | 1    | 1.072 | 0    | 1.074 | 0    | 1.076 | 0    |

NO. OF ACCEPTED EVENTS= 9807

MAX. THETA= 15.0

MEAN PATHLENGTH= 1.03314

SIGMA= 0.01306

GEOM. FACTOR= 1.684

CALC. GEOM. FACTOR 1.691

```
10000 5 0
1.000 0.000 0.000
1.000 0.800 0.000
1.000 1.300 0.000
1.000 0.800 3.141
1.000 1.300 3.141
```

```
PATHVA --- ERROR 73
FLOATING ZERO DIVIDE
AT PC = 023616
IN ".MAIN." AT OR AFTER 00084
```

```
PATHVA --- EXITING DUE TO ERROR 3
ODD ADDRESS TRAP (SSIO)
AT INC = 020A10. AT OR AFTER 00125
```

```
MCR>FOR PATHVAR,LP:+PATHVAR,FTN/TR:ALL^U
FOR PATHVAR,LP:=PATHVAR,FTN/TR:ALL
MCR>TKB PATHVAR,LP:/SH=PATHVAR
MCR>SYS
```

ATL:

```
DB.... TT.... LP.... MM.... CR.... VGCMM ...SYS MO.... VGI
GEAP ...TKB
```

MRL:

NO ENTRIES

MCR>RUN PATHVAR\$

CKQ:

NO ENTRIES

EXECUTION BEGUN

MCR>

SELECT OUTPUT MODE:2

MCR --- TASK NOT INSTALLED

ENTER INITIAL VALUES FOR RAN:(2I4)

MCR>

DEBUG OUTPUT?

FLAT DETECTOR, 8CM-2, 25 DEGREES

```
1.596 1.596 6.8451000.000
```

```
10000 5 0
```

```
1.000 0.000 0.000
```

```
1.000 0.800 0.000
```

```
1.000 1.300 0.000
```

```
1.000 0.800 3.141
```

```
1.000 1.300 3.141
```

DETECTOR: FLAT DETECTOR, 8CM-2, 25 DEGREES

DETECTOR RADII: R1= 1.596 R2= 1.596

SEPARATION: D= 6.845

RADIUS OF CURVATURE: RC=1000.000

# OF EVENTS 1000

| THKNESS | RADIUS | ANGLE |
|---------|--------|-------|
| 1.000   | 0.000  | 0.000 |
| 1.000   | 0.800  | 0.000 |
| 1.000   | 1.300  | 0.000 |
| 1.000   | 0.800  | 3.141 |
| 1.000   | 1.300  | 3.141 |

| PATHL | NACC | PATHL | NACC | PATHL | NACC | PATHL | NACC |
|-------|------|-------|------|-------|------|-------|------|
| 0.998 | 0    | 1.000 | 203  | 1.002 | 197  | 1.004 | 164  |
| 1.006 | 140  | 1.008 | 127  | 1.010 | 129  | 1.012 | 86   |
| 1.014 | 136  | 1.016 | 119  | 1.018 | 101  | 1.020 | 109  |
| 1.022 | 95   | 1.024 | 101  | 1.026 | 72   | 1.028 | 80   |
| 1.030 | 70   | 1.032 | 69   | 1.034 | 66   | 1.036 | 55   |
| 1.038 | 52   | 1.040 | 54   | 1.042 | 60   | 1.044 | 49   |
| 1.046 | 51   | 1.048 | 36   | 1.050 | 43   | 1.052 | 38   |
| 1.054 | 42   | 1.056 | 36   | 1.058 | 35   | 1.060 | 27   |
| 1.062 | 27   | 1.064 | 15   | 1.066 | 16   | 1.068 | 16   |
| 1.070 | 19   | 1.072 | 14   | 1.074 | 12   | 1.076 | 15   |
| 1.078 | 9    | 1.080 | 9    | 1.082 | 8    | 1.084 | 4    |
| 1.086 | 6    | 1.088 | 5    | 1.090 | 5    | 1.092 | 1    |
| 1.094 | 2    | 1.096 | 0    | 1.098 | 0    | 1.100 | 0    |

NO. OF ACCEPTED EVENTS= 2825  
 MAX. THETA= 24.9  
 MEAN PATHLENGTH= 1.02421  
 SIGMA= 0.02063  
 GEOM. FACTOR= 1.260  
 CALC. GEOM. FACTOR 1.236  
 PATHVA -- STOP

MCR>

~~MCR -- TASK NOT INSTALLED~~

~~MCR>~~

~~MCR>~~

~~MCR>EEEE^U~~

~~EDI INPUT.DAT~~

~~CPAGE 11~~

~~\*NPF1~~

~~FLAT DETECTOR, 8CM-2, 25 DEGREES~~

~~\*C/25/20~~

~~FLAT DETECTOR, 8CM-2, 20 DEGREES~~

~~\*NPF1~~

~~1.596 1.596 6.845 1000.~~

~~\*C/6.845/8.77 /~~

|       |    |       |    |       |    |       |    |
|-------|----|-------|----|-------|----|-------|----|
| 1.038 | 52 | 1.040 | 54 | 1.042 | 60 | 1.044 | 47 |
| 1.046 | 51 | 1.048 | 36 | 1.050 | 43 | 1.052 | 38 |
| 1.054 | 42 | 1.056 | 36 | 1.058 | 35 | 1.060 | 27 |
| 1.062 | 27 | 1.064 | 15 | 1.066 | 16 | 1.068 | 16 |
| 1.070 | 19 | 1.072 | 14 | 1.074 | 12 | 1.076 | 15 |
| 1.078 | 9  | 1.080 | 9  | 1.082 | 8  | 1.084 | 4  |
| 1.086 | 6  | 1.088 | 5  | 1.090 | 5  | 1.092 | 1  |
| 1.094 | 2  | 1.096 | 0  | 1.098 | 0  | 1.100 | 0  |

NO. OF ACCEPTED EVENTS= 2825

MAX. THETA= 24.9

MEAN PATHLENGTH= 1.02421

SIGMA= 0.02063

GEOM. FACTOR= 1.260

CALC. GEOM. FACTOR 1.236

PATHVA -- STOP

MCR>

MCR -- TASK NOT INSTALLED

MCR>

MCR>

MCR>EEEE^U

EDI INPUT.DAT

[PAGE 1]

\*NP1

FLAT DETECTOR, 8CM-2, 25 DEGREES

\*C/25/20

FLAT DETECTOR, 8CM-2, 20 DEGREES

\*NP1

1.596 1.596 6.845 1000.

\*C/6.845/8.77 /

1.596 1.596 8.77 1000.

\*EX

[EDI -- EXIT]

MCR>RUN PATHVAR\$

EXECUTION BEGUN

SELECT OUTPUT MODE:2

ENTER INITIAL VALUES FOR RAN:(214)

DEBUG OUTPUT?

FLAT DETECTOR, 8CM-2, 20 DEGREES

1.596 1.596 8.7701000.000

10000 5 0

1.000 0.000 0.000

1.000 0.800 0.000

1.000 1.300 0.000

1.000 0.800 3.141

DETECTOR: FLAT DETECTOR, 8CM-2, 20 DEGREES

DETECTOR RADII: R1= 1.596 R2= 1.596

SEPARATION: D= 8.770

RADIUS OF CURVATURE: RC=1000.000

NO. OF EVENTS 10000

| THKNSS | RADIUS | ANGLE |
|--------|--------|-------|
| 1.000  | 0.000  | 0.000 |
| 1.000  | 0.800  | 0.000 |
| 1.000  | 1.300  | 0.000 |
| 1.000  | 0.800  | 3.141 |
| 1.000  | 1.300  | 3.141 |

| PATHL | NACC | PATHL | NACC | PATHL | NACC | PATHL | NACC |
|-------|------|-------|------|-------|------|-------|------|
| 0.998 | 0    | 1.000 | 302  | 1.002 | 265  | 1.004 | 206  |
| 1.006 | 189  | 1.008 | 157  | 1.010 | 187  | 1.012 | 166  |
| 1.014 | 146  | 1.016 | 126  | 1.018 | 118  | 1.020 | 103  |
| 1.022 | 94   | 1.024 | 80   | 1.026 | 84   | 1.028 | 76   |
| 1.030 | 61   | 1.032 | 63   | 1.034 | 61   | 1.036 | 59   |
| 1.038 | 47   | 1.040 | 23   | 1.042 | 25   | 1.044 | 29   |
| 1.046 | 19   | 1.048 | 18   | 1.050 | 12   | 1.052 | 11   |
| 1.054 | 8    | 1.056 | 4    | 1.058 | 3    | 1.060 | 0    |

NO. OF ACCEPTED EVENTS= 2742

MAX. THETA= 19.9

MEAN PATHLENGTH= 1.01494

SIGMA= 0.01294

GEOM. FACTOR= 0.799

CALC. GEOM. FACTOR 0.782

DETECTOR: PLANE SURFACE *NJS Dimensions*

DETECTOR RADII: R1= 1.596 R2= 1.596  
SEPARATION: D= 5.740  
RADIUS OF CURVATURE: RC=1000.000  
NO. OF EVENTS 10000

| THKNSS | RADIUS | ANGLE |
|--------|--------|-------|
| 1.000  | 0.000  | 0.000 |
| 1.000  | 1.596  | 0.000 |
| 1.000  | 1.596  | 1.570 |
| 1.000  | 1.596  | 3.141 |
| 1.000  | 1.596  | 4.712 |

| PATHL | NACC | PATHL | NACC | PATHL | NACC | PATHL | NACC |
|-------|------|-------|------|-------|------|-------|------|
| 0.998 | 0    | 1.000 | 163  | 1.002 | 156  | 1.004 | 138  |
| 1.006 | 105  | 1.008 | 130  | 1.010 | 111  | 1.012 | 109  |
| 1.014 | 106  | 1.016 | 93   | 1.018 | 69   | 1.020 | 81   |
| 1.022 | 97   | 1.024 | 71   | 1.026 | 74   | 1.028 | 75   |
| 1.030 | 69   | 1.032 | 68   | 1.034 | 71   | 1.036 | 48   |
| 1.038 | 55   | 1.040 | 39   | 1.042 | 52   | 1.044 | 55   |
| 1.046 | 51   | 1.048 | 46   | 1.050 | 41   | 1.052 | 45   |
| 1.054 | 44   | 1.056 | 45   | 1.058 | 32   | 1.060 | 32   |
| 1.062 | 29   | 1.064 | 47   | 1.066 | 33   | 1.068 | 34   |
| 1.070 | 33   | 1.072 | 22   | 1.074 | 20   | 1.076 | 19   |
| 1.078 | 18   | 1.080 | 21   | 1.082 | 15   | 1.084 | 24   |
| 1.086 | 13   | 1.088 | 18   | 1.090 | 15   | 1.092 | 18   |
| 1.094 | 10   | 1.096 | 12   | 1.098 | 10   | 1.100 | 10   |
| 1.102 | 10   | 1.104 | 7    | 1.106 | 7    | 1.108 | 6    |
| 1.110 | 6    | 1.112 | 5    | 1.114 | 2    | 1.116 | 5    |
| 1.118 | 4    | 1.120 | 5    | 1.122 | 4    | 1.124 | 1    |
| 1.126 | 1    | 1.128 | 2    | 1.130 | 1    | 1.132 | 0    |
| 1.134 | 0    | 1.136 | 1    | 1.138 | 0    | 1.140 | 0    |

NO. OF ACCEPTED EVENTS= 2859  
MAX. THETA= 29.0  
MEAN PATHLENGTH= 1.03240  
SIGMA= 0.02803  
GEOM. FACTOR= 1.688  
CALC. GEOM. FACTOR 1.691

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# CRS Engineering Units Conversion

$$EU = A_0 + A_1x + A_2x^2 + \dots + A_5x^5$$

$$x = \text{DATA Number (0-255)}$$

JPL  $\rightarrow$  TG  
7-25-77

RUN 0407 0022CRS

MJS77 SERIAL NO..... MJS-2  
 MJS77 FUNCTION ..... CRS ELECTRONICS TEMP  
 FDS TREESWITCH ID .. 57  
 FDS RANGE ..... 350-700 OHMS  
 FDS SERIAL NO..... 2  
 SUBASSY REF NO..... 2021  
 SUBASSY SERIAL NO... 002  
 MEAS CALIB RANGE ... -70 TO +100 DEG C  
 MEAS CALIB TEMP .... -  
 XDUCER SERIAL NO.... K006  
 XDUCER IMPEDANCE ... -  
 XDUCER CALIB DATE .. 9 OCT 74  
 DATA PREPARED BY ... ROSEMOUNT ENGR CO  
 APPROVED BY ... JPL  
 APPROVED BY ... R. ROTTER  
 RUN DATE ..... 0407 0022CRS

STANDARD DEVIATION . .40724108+00  
 COEFFICIENT A0 ..... -.78381954+02  
 COEFFICIENT A1 ..... .70555313+00

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| -70.00          | 11.09        | -70.5606      | .560578  |
| -30.00          | 68.83        | -29.7784      | -.221573 |
| .00             | 111.71       | .4377         | -.437740 |
| 30.00           | 154.16       | 30.3840       | -.384032 |
| 60.00           | 196.21       | 60.0553       | -.055350 |
| 90.00           | 237.89       | 89.4619       | .538116  |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      |
|-----|--------|--------|--------|--------|--------|
| 0   | -78.38 | -76.97 | -75.56 | -74.15 | -72.74 |
| 10  | -71.93 | -69.92 | -68.50 | -67.09 | -65.68 |
| 20  | -64.27 | -62.86 | -61.45 | -60.04 | -58.63 |
| 30  | -57.22 | -55.80 | -54.39 | -52.98 | -51.57 |
| 40  | -50.16 | -48.75 | -47.34 | -45.93 | -44.52 |
| 50  | -43.10 | -41.69 | -40.28 | -38.87 | -37.46 |
| 60  | -36.05 | -34.64 | -33.23 | -31.82 | -30.40 |
| 70  | -28.99 | -27.58 | -26.17 | -24.76 | -23.35 |
| 80  | -21.94 | -20.53 | -19.12 | -17.70 | -16.29 |
| 90  | -14.88 | -13.47 | -12.06 | -10.65 | -9.24  |
| 100 | -7.83  | -6.42  | -5.00  | -3.59  | -2.18  |
| 110 | -.77   | .64    | 2.05   | 3.46   | 4.87   |
| 120 | 6.28   | 7.70   | 9.11   | 10.52  | 11.93  |
| 130 | 13.34  | 14.75  | 16.16  | 17.57  | 18.98  |
| 140 | 20.40  | 21.81  | 23.22  | 24.63  | 26.04  |
| 150 | 27.45  | 28.86  | 30.27  | 31.68  | 33.10  |
| 160 | 34.51  | 35.92  | 37.33  | 38.74  | 40.15  |
| 170 | 41.56  | 42.97  | 44.38  | 45.80  | 47.21  |
| 180 | 48.62  | 50.03  | 51.44  | 52.85  | 54.26  |
| 190 | 55.67  | 57.08  | 58.50  | 59.91  | 61.32  |
| 200 | 62.73  | 64.14  | 65.55  | 66.96  | 68.37  |
| 210 | 69.78  | 71.20  | 72.61  | 74.02  | 75.43  |
| 220 | 76.84  | 78.25  | 79.66  | 81.07  | 82.48  |
| 230 | 83.90  | 85.31  | 86.72  | 88.13  | 89.54  |
| 240 | 90.95  | 92.36  | 93.77  | 95.18  | 96.60  |
| 250 | 98.01  | 99.42  | 100.83 | 102.24 |        |

DEG C

RUN 0407 0022CRS

MJS77 SERIAL NO..... MJS-2  
MJS77 FUNCTION ..... CRS TELESCOPE TEMP

FDS TREESWITCH ID .. D7  
FDS RANGE ..... 350-700 OHMS  
FDS SERIAL NO..... 2

SUEASSY REF NO..... 2021  
SUEASSY SERIAL NO... 002

MEAS CALIB RANGE ... -70 TO +100 DEG C  
MEAS CALIB TEMP .... -

REDUCER SERIAL NO.... K007  
REDUCER IMPEDANCE ... -  
REDUCER CALIB DATE .. 9 OCT 74

DATA PREPARED BY ... ROSEMOUNT ENGR CO  
APPROVED BY ... JPL  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0407 0022CRS

STANDARD DEVIATION . .38996230+00

COEFFICIENT A0 ..... -.79948574+02  
COEFFICIENT A1 ..... .70323788+00

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| -70.00          | 13.39        | -70.5413      | .541270  |
| -30.00          | 71.34        | -29.7797      | -.220331 |
| .00             | 114.29       | .4222         | -.422193 |
| 30.00           | 156.86       | 30.3601       | -.360064 |
| 60.00           | 199.02       | 60.0492       | -.049169 |
| 90.00           | 240.94       | 89.4895       | .510484  |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      | FRAME 59 |
|-----|--------|--------|--------|--------|--------|----------|
| 0   | -79.95 | -78.54 | -77.14 | -75.73 | -74.32 |          |
| 10  | -72.92 | -71.51 | -70.10 | -68.70 | -67.29 |          |
| 20  | -65.88 | -64.48 | -63.07 | -61.66 | -60.26 |          |
| 30  | -58.85 | -57.44 | -56.04 | -54.63 | -53.23 |          |
| 40  | -51.82 | -50.41 | -49.01 | -47.60 | -46.19 |          |
| 50  | -44.79 | -43.38 | -41.97 | -40.57 | -39.16 |          |
| 60  | -37.75 | -36.35 | -34.94 | -33.53 | -32.13 |          |
| 70  | -30.72 | -29.32 | -27.91 | -26.50 | -25.10 |          |
| 80  | -23.69 | -22.28 | -20.88 | -19.47 | -18.06 |          |
| 90  | -16.66 | -15.25 | -13.84 | -12.44 | -11.03 |          |
| 100 | -9.62  | -8.22  | -6.81  | -5.41  | -4.00  |          |
| 110 | -2.59  | -1.19  | .22    | 1.63   | 3.03   |          |
| 120 | 4.44   | 5.85   | 7.25   | 8.66   | 10.07  |          |
| 130 | 11.47  | 12.88  | 14.29  | 15.69  | 17.10  |          |
| 140 | 18.50  | 19.91  | 21.32  | 22.72  | 24.13  |          |
| 150 | 25.54  | 26.94  | 28.35  | 29.76  | 31.16  |          |
| 160 | 32.57  | 33.98  | 35.38  | 36.79  | 38.20  |          |
| 170 | 39.60  | 41.01  | 42.41  | 43.82  | 45.23  |          |
| 180 | 46.63  | 48.04  | 49.45  | 50.85  | 52.26  |          |
| 190 | 53.67  | 55.07  | 56.48  | 57.89  | 59.29  |          |
| 200 | 60.70  | 62.11  | 63.51  | 64.92  | 66.32  |          |
| 210 | 67.73  | 69.14  | 70.54  | 71.95  | 73.36  |          |
| 220 | 74.76  | 76.17  | 77.58  | 78.98  | 80.39  |          |
| 230 | 81.80  | 83.20  | 84.61  | 86.02  | 87.42  |          |
| 240 | 88.83  | 90.23  | 91.64  | 93.05  | 94.45  |          |
| 250 | 95.86  | 97.27  | 98.67  | 100.08 |        |          |

DEG C

RUN 0327 0012CRS

MJS77 SERIAL NO..... MJS-2  
MJS77 FUNCTION ..... +10 V PWR SUPPLY VOLTAGE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 2

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 001

MEAS CALIB RANGE ... 0-12 VOLTS  
MEAS CALIB TEMP .... N/A

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ...  
XDUCER CALIB DATE .. 28 JUN 76

DATA PREPARED BY ... CSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0327 0012CRS

STANDARD DEVIATION . .72224764-07

COEFFICIENT A0 ..... .76760255-02  
COEFFICIENT A1 ..... .41433451-01

| MEASURAND | OUTPUT | F(X)    | DELTA   |
|-----------|--------|---------|---------|
| EU        | DN     | PRIME   |         |
| .00       | -.19   | -.0000  | .000000 |
| 2.00      | 48.08  | 2.0000  | .000000 |
| 4.00      | 96.36  | 4.0000  | .000000 |
| 6.00      | 144.63 | 6.0000  | .000000 |
| 8.00      | 192.90 | 8.0000  | .000000 |
| 10.00     | 241.17 | 10.0000 | .000000 |
| 12.00     | 289.44 | 12.0000 | .000000 |

DATA NUMBER

|     | 0     | 2     | 4     | 6     | 8     |
|-----|-------|-------|-------|-------|-------|
| 0   | .01   | .09   | .17   | .26   | .34   |
| 10  | .42   | .50   | .59   | .67   | .75   |
| 20  | .84   | .92   | 1.00  | 1.08  | 1.17  |
| 30  | 1.25  | 1.33  | 1.42  | 1.50  | 1.58  |
| 40  | 1.67  | 1.75  | 1.83  | 1.91  | 2.00  |
| 50  | 2.08  | 2.16  | 2.25  | 2.33  | 2.41  |
| 60  | 2.49  | 2.58  | 2.66  | 2.74  | 2.83  |
| 70  | 2.91  | 2.99  | 3.07  | 3.16  | 3.24  |
| 80  | 3.32  | 3.41  | 3.49  | 3.57  | 3.65  |
| 90  | 3.74  | 3.82  | 3.90  | 3.99  | 4.07  |
| 100 | 4.15  | 4.23  | 4.32  | 4.40  | 4.48  |
| 110 | 4.57  | 4.65  | 4.73  | 4.81  | 4.90  |
| 120 | 4.98  | 5.06  | 5.15  | 5.23  | 5.31  |
| 130 | 5.39  | 5.48  | 5.56  | 5.64  | 5.73  |
| 140 | 5.81  | 5.89  | 5.97  | 6.06  | 6.14  |
| 150 | 6.22  | 6.31  | 6.39  | 6.47  | 6.55  |
| 160 | 6.64  | 6.72  | 6.80  | 6.89  | 6.97  |
| 170 | 7.05  | 7.13  | 7.22  | 7.30  | 7.38  |
| 180 | 7.47  | 7.55  | 7.63  | 7.71  | 7.80  |
| 190 | 7.88  | 7.96  | 8.05  | 8.13  | 8.21  |
| 200 | 8.29  | 8.38  | 8.46  | 8.54  | 8.63  |
| 210 | 8.71  | 8.79  | 8.87  | 8.96  | 9.04  |
| 220 | 9.12  | 9.21  | 9.29  | 9.37  | 9.45  |
| 230 | 9.54  | 9.62  | 9.70  | 9.79  | 9.87  |
| 240 | 9.95  | 10.03 | 10.12 | 10.20 | 10.28 |
| 250 | 10.37 | 10.45 | 10.53 | 10.61 |       |

VOLTS

RUN 0327 0012CRS

MJS77 SERIAL NO..... MJS-2  
MJS77 FUNCTION ..... +6 V PWR SUPPLY VOLTAGE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 2

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 001

MEAS CALIB RANGE ... 0-8 VOLTS  
MEAS CALIB TEMP .... N/A

XDUCER SERIAL NO..... -  
XDUCER IMPEDANCE ...  
XDUCER CALIB DATE .. 28 JUN 76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0327 0012CRS

STANDARD DEVIATION . .61077368-07

COEFFICIENT A0 ..... .45322115-02  
COEFFICIENT A1 ..... .24463826-01

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA   |
|-----------------|--------------|---------------|---------|
| .00             | -.19         | -.0000        | .000000 |
| 2.00            | 81.57        | 2.0000        | .000000 |
| 4.00            | 163.32       | 4.0000        | .000000 |
| 6.00            | 245.07       | 6.0000        | .000000 |
| 8.00            | 326.83       | 8.0000        | .000000 |

DATA NUMBER

|  | 0   | 2    | 4    | 6    | 8    | 9    |
|--|-----|------|------|------|------|------|
|  | 0   | .00  | .05  | .10  | .15  | .20  |
|  | 10  | .25  | .30  | .35  | .40  | .44  |
|  | 20  | .49  | .54  | .59  | .64  | .69  |
|  | 30  | .74  | .79  | .84  | .89  | .93  |
|  | 40  | .98  | 1.03 | 1.08 | 1.13 | 1.18 |
|  | 50  | 1.23 | 1.28 | 1.33 | 1.37 | 1.42 |
|  | 60  | 1.47 | 1.52 | 1.57 | 1.62 | 1.67 |
|  | 70  | 1.72 | 1.77 | 1.81 | 1.86 | 1.91 |
|  | 80  | 1.96 | 2.01 | 2.06 | 2.11 | 2.16 |
|  | 90  | 2.21 | 2.26 | 2.30 | 2.35 | 2.40 |
|  | 100 | 2.45 | 2.50 | 2.55 | 2.60 | 2.65 |
|  | 110 | 2.70 | 2.74 | 2.79 | 2.84 | 2.89 |
|  | 120 | 2.94 | 2.99 | 3.04 | 3.09 | 3.14 |
|  | 130 | 3.18 | 3.23 | 3.28 | 3.33 | 3.38 |
|  | 140 | 3.43 | 3.48 | 3.53 | 3.58 | 3.63 |
|  | 150 | 3.67 | 3.72 | 3.77 | 3.82 | 3.87 |
|  | 160 | 3.92 | 3.97 | 4.02 | 4.07 | 4.11 |
|  | 170 | 4.16 | 4.21 | 4.26 | 4.31 | 4.36 |
|  | 180 | 4.41 | 4.46 | 4.51 | 4.55 | 4.60 |
|  | 190 | 4.65 | 4.70 | 4.75 | 4.80 | 4.85 |
|  | 200 | 4.90 | 4.95 | 5.00 | 5.04 | 5.09 |
|  | 210 | 5.14 | 5.19 | 5.24 | 5.29 | 5.34 |
|  | 220 | 5.39 | 5.44 | 5.48 | 5.53 | 5.58 |
|  | 230 | 5.63 | 5.68 | 5.73 | 5.78 | 5.83 |
|  | 240 | 5.88 | 5.92 | 5.97 | 6.02 | 6.07 |
|  | 250 | 6.12 | 6.17 | 6.22 | 6.27 |      |

VOLTS

RUN 0327 0012CRS

MJS77 SERIAL NO..... MJS-2  
MJS77 FUNCTION ..... +3 V POWER SUPPLY VOLTAGE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 2

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 001

MEAS CALIB RANGE ... 0-4 VOLTS  
MEAS CALIB TEMP .... N/A

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ...  
XDUCER CALIB DATE .. 28 JUN 76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0327 0012CRS

STANDARD DEVIATION . .25424024-03

COEFFICIENT A0 ..... .20550631-02  
COEFFICIENT A1 ..... .12212869-01

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| .00             | - .19        | - .0002       | .000208  |
| 1.00            | 81.74        | 1.0003        | -.000311 |
| 2.00            | 163.58       | 1.9998        | .000208  |
| 3.00            | 245.50       | 3.0003        | -.000311 |
| 4.00            | 327.34       | 3.9998        | .000208  |

DATA NUMBER

|     | 0     | 2    | 4    | 6    | 8    | 13 |
|-----|-------|------|------|------|------|----|
|     | FRAME |      |      |      |      |    |
| 0   | .00   | .03  | .05  | .08  | .10  |    |
| 10  | .12   | .15  | .17  | .20  | .22  |    |
| 20  | .25   | .27  | .30  | .32  | .34  |    |
| 30  | .37   | .39  | .42  | .44  | .47  |    |
| 40  | .49   | .51  | .54  | .56  | .59  |    |
| 50  | .61   | .64  | .66  | .69  | .71  |    |
| 60  | .73   | .76  | .78  | .81  | .83  |    |
| 70  | .86   | .88  | .91  | .93  | .95  |    |
| 80  | .98   | 1.00 | 1.03 | 1.05 | 1.08 |    |
| 90  | 1.10  | 1.13 | 1.15 | 1.17 | 1.20 |    |
| 100 | 1.22  | 1.25 | 1.27 | 1.30 | 1.32 |    |
| 110 | 1.35  | 1.37 | 1.39 | 1.42 | 1.44 |    |
| 120 | 1.47  | 1.49 | 1.52 | 1.54 | 1.57 |    |
| 130 | 1.59  | 1.61 | 1.64 | 1.66 | 1.69 |    |
| 140 | 1.71  | 1.74 | 1.76 | 1.79 | 1.81 |    |
| 150 | 1.83  | 1.86 | 1.88 | 1.91 | 1.93 |    |
| 160 | 1.96  | 1.98 | 2.00 | 2.03 | 2.05 |    |
| 170 | 2.08  | 2.10 | 2.13 | 2.15 | 2.18 |    |
| 180 | 2.20  | 2.22 | 2.25 | 2.27 | 2.30 |    |
| 190 | 2.32  | 2.35 | 2.37 | 2.40 | 2.42 |    |
| 200 | 2.44  | 2.47 | 2.49 | 2.52 | 2.54 |    |
| 210 | 2.57  | 2.59 | 2.62 | 2.64 | 2.66 |    |
| 220 | 2.69  | 2.71 | 2.74 | 2.76 | 2.79 |    |
| 230 | 2.81  | 2.84 | 2.86 | 2.88 | 2.91 |    |
| 240 | 2.93  | 2.96 | 2.98 | 3.01 | 3.03 |    |
| 250 | 3.06  | 3.08 | 3.10 | 3.13 |      |    |

VOLTS

RUN 0327 0012CRS

FRAME 17

MJS77 SERIAL NO..... MJS-2  
MJS77 FUNCTION ..... LET A TEMPERATURE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 2

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 001

MEAS CALIB RANGE ... +40 TO -50 DEG C  
MEAS CALIB TEMP .... N/A

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ...  
XDUCER CALIB DATE .. 28 JUN 76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0327 0012CRS

STANDARD DEVIATION . .50988927+00

COEFFICIENT A0 ..... .66379682+02  
COEFFICIENT A1 ..... -.99478929+00  
COEFFICIENT A2 ..... .46812111-02  
COEFFICIENT A3 ..... -.10488078-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.77        | 39.1651       | .834903  |
| 30.00           | 44.18        | 30.6653       | -.665348 |
| 20.00           | 61.00        | 20.7345       | -.734491 |
| 10.00           | 83.27        | 9.9479        | .052094  |
| .00             | 110.63       | -.5821        | .582141  |
| -10.00          | 141.06       | -10.2357      | .235660  |
| -20.00          | 173.18       | -19.9761      | -.023929 |
| -30.00          | 201.56       | -29.8339      | -.166099 |
| -40.00          | 224.00       | -39.4482      | -.551797 |
| -50.00          | 244.73       | -50.4369      | .436880  |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      |
|-----|--------|--------|--------|--------|--------|
| 0   | 66.38  | 64.41  | 62.47  | 60.58  | 58.72  |
| 10  | 56.89  | 55.10  | 53.34  | 51.62  | 49.93  |
| 20  | 48.27  | 46.65  | 45.06  | 43.50  | 41.97  |
| 30  | 40.47  | 39.00  | 37.56  | 36.14  | 34.76  |
| 40  | 33.41  | 32.08  | 30.78  | 29.50  | 28.26  |
| 50  | 27.03  | 25.83  | 24.66  | 23.51  | 22.38  |
| 60  | 21.28  | 20.20  | 19.14  | 18.10  | 17.08  |
| 70  | 16.08  | 15.11  | 14.15  | 13.21  | 12.29  |
| 80  | 11.39  | 10.50  | 9.63   | 8.78   | 7.94   |
| 90  | 7.12   | 6.31   | 5.52   | 4.74   | 3.98   |
| 100 | 3.22   | 2.48   | 1.76   | 1.04   | .33    |
| 110 | -.36   | -1.05  | -1.73  | -2.40  | -3.06  |
| 120 | -3.71  | -4.35  | -4.99  | -5.62  | -6.25  |
| 130 | -6.87  | -7.49  | -8.10  | -8.71  | -9.32  |
| 140 | -9.92  | -10.52 | -11.12 | -11.72 | -12.31 |
| 150 | -12.91 | -13.51 | -14.10 | -14.70 | -15.30 |
| 160 | -15.91 | -16.51 | -17.12 | -17.74 | -18.35 |
| 170 | -18.98 | -19.60 | -20.24 | -20.88 | -21.52 |
| 180 | -22.18 | -22.84 | -23.51 | -24.19 | -24.88 |
| 190 | -25.58 | -26.29 | -27.00 | -27.74 | -28.48 |
| 200 | -29.23 | -30.00 | -30.78 | -31.58 | -32.39 |
| 210 | -33.21 | -34.06 | -34.91 | -35.78 | -36.67 |
| 220 | -37.58 | -38.51 | -39.45 | -40.41 | -41.39 |
| 230 | -42.39 | -43.42 | -44.46 | -45.52 | -46.61 |
| 240 | -47.72 | -48.85 | -50.01 | -51.19 | -52.39 |
| 250 | -53.62 | -54.87 | -56.15 | -57.46 |        |

DEG C

E-372

CRS LA T

LETA

RUN 0327 0012CRS

MJS77 SERIAL NO..... MJS-2  
MJS77 FUNCTION ..... LET B TEMPERATURE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 2

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 001

MEAS CALIB RANGE ... +40 TO -50 DEG C  
MEAS CALIB TEMP .... N/A

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ...  
XDUCER CALIB DATE .. 28 JUN 78

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0327 0012CRS

STANDARD DEVIATION . .44052282+00

COEFFICIENT A0 ..... .68213680+02  
COEFFICIENT A1 ..... -.10653336+01  
COEFFICIENT A2 ..... .54026245-02  
COEFFICIENT A3 ..... -.12564523-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.77        | 39.4195       | .580482  |
| 30.00           | 44.18        | 30.6118       | -.611827 |
| 20.00           | 61.00        | 20.4783       | -.478338 |
| 10.00           | 83.27        | 9.7110        | .289042  |
| .00             | 110.63       | -.5346        | .534564  |
| -10.00          | 141.57       | -9.9747       | -.025333 |
| -20.00          | 173.18       | -19.5076      | -.492360 |
| -30.00          | 201.56       | -29.9138      | -.086203 |
| -40.00          | 224.00       | -40.5565      | .556492  |
| -50.00          | 239.64       | -49.7335      | -.266509 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      |
|-----|--------|--------|--------|--------|--------|
| 0   | 68.21  | 66.10  | 64.04  | 62.01  | 60.03  |
| 10  | 58.09  | 56.19  | 54.32  | 52.50  | 50.71  |
| 20  | 48.97  | 47.26  | 45.58  | 43.95  | 42.34  |
| 30  | 40.78  | 39.24  | 37.74  | 36.28  | 34.84  |
| 40  | 33.44  | 32.07  | 30.73  | 29.42  | 28.14  |
| 50  | 26.88  | 25.66  | 24.46  | 23.29  | 22.15  |
| 60  | 21.03  | 19.94  | 18.87  | 17.82  | 16.80  |
| 70  | 15.80  | 14.83  | 13.87  | 12.94  | 12.02  |
| 80  | 11.13  | 10.26  | 9.40   | 8.56   | 7.74   |
| 90  | 6.94   | 6.15   | 5.37   | 4.62   | 3.87   |
| 100 | 3.14   | 2.42   | 1.72   | 1.03   | .35    |
| 110 | -.32   | -.99   | -1.64  | -2.28  | -2.91  |
| 120 | -3.54  | -4.16  | -4.77  | -5.38  | -5.98  |
| 130 | -6.58  | -7.17  | -7.76  | -8.35  | -8.94  |
| 140 | -9.52  | -10.10 | -10.68 | -11.27 | -11.85 |
| 150 | -12.43 | -13.02 | -13.61 | -14.20 | -14.80 |
| 160 | -15.40 | -16.00 | -16.61 | -17.23 | -17.86 |
| 170 | -18.49 | -19.13 | -19.77 | -20.43 | -21.10 |
| 180 | -21.78 | -22.47 | -23.17 | -23.88 | -24.61 |
| 190 | -25.35 | -26.10 | -26.87 | -27.65 | -28.45 |
| 200 | -29.26 | -30.10 | -30.95 | -31.82 | -32.70 |
| 210 | -33.61 | -34.54 | -35.49 | -36.45 | -37.45 |
| 220 | -38.46 | -39.50 | -40.56 | -41.64 | -42.75 |
| 230 | -43.89 | -45.05 | -46.24 | -47.45 | -48.70 |
| 240 | -49.97 | -51.27 | -52.60 | -53.96 | -55.35 |
| 250 | -56.78 | -58.23 | -59.72 | -61.24 |        |

DEG C

RUN 0327 0012CRS

MJS77 SERIAL NO..... MJS-2  
MJS77 FUNCTION ..... LET C TEMPERATURE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 2

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 001

MEAS CALIB RANGE ... +40 TO -50 DEG C  
MEAS CALIB TEMP .... N/A

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ...  
XDUCER CALIB DATE .. 28 JUN 76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0327 0012CRS

STANDARD DEVIATION . .40210972+01

COEFFICIENT A0 ..... .67793588+02  
COEFFICIENT A1 ..... -.10399139+01  
COEFFICIENT A2 ..... .49987052-02  
COEFFICIENT A3 ..... -.10861130-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA     |
|-----------------|--------------|---------------|-----------|
| 40.00           | 31.77        | 39.4539       | .546064   |
| 30.00           | 44.18        | 30.6733       | -.673271  |
| 20.00           | 61.00        | 20.4925       | -.492494  |
| 10.00           | 83.27        | 9.5904        | .409636   |
| .00             | 110.63       | -.7796        | .779644   |
| -10.00          | 141.57       | -10.0584      | .058384   |
| -20.00          | 173.18       | -18.7924      | -1.207619 |
| -30.00          | 232.67       | -40.3585      | 10.358523 |
| -40.00          | 224.00       | -36.4045      | -3.595462 |
| -50.00          | 239.64       | -43.8166      | -6.183401 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      |
|-----|--------|--------|--------|--------|--------|
| 0   | 67.79  | 65.73  | 63.71  | 61.73  | 59.79  |
| 10  | 57.88  | 56.02  | 54.18  | 52.39  | 50.63  |
| 20  | 48.91  | 47.22  | 45.56  | 43.94  | 42.36  |
| 30  | 40.80  | 39.28  | 37.79  | 36.33  | 34.90  |
| 40  | 33.50  | 32.13  | 30.79  | 29.48  | 28.19  |
| 50  | 26.94  | 25.71  | 24.50  | 23.33  | 22.18  |
| 60  | 21.05  | 19.95  | 18.87  | 17.81  | 16.78  |
| 70  | 15.77  | 14.78  | 13.81  | 12.86  | 11.94  |
| 80  | 11.03  | 10.14  | 9.27   | 8.42   | 7.59   |
| 90  | 6.77   | 5.97   | 5.19   | 4.42   | 3.67   |
| 100 | 2.93   | 2.20   | 1.49   | .79    | .11    |
| 110 | -.57   | -1.23  | -1.88  | -2.53  | -3.16  |
| 120 | -3.78  | -4.40  | -5.00  | -5.60  | -6.19  |
| 130 | -6.78  | -7.36  | -7.93  | -8.50  | -9.06  |
| 140 | -9.62  | -10.18 | -10.73 | -11.28 | -11.83 |
| 150 | -12.38 | -12.93 | -13.47 | -14.02 | -14.56 |
| 160 | -15.11 | -15.66 | -16.21 | -16.77 | -17.33 |
| 170 | -17.89 | -18.46 | -19.03 | -19.60 | -20.19 |
| 180 | -20.77 | -21.37 | -21.97 | -22.58 | -23.20 |
| 190 | -23.83 | -24.47 | -25.12 | -25.78 | -26.45 |
| 200 | -27.13 | -27.82 | -28.53 | -29.25 | -29.98 |
| 210 | -30.73 | -31.49 | -32.27 | -33.06 | -33.87 |
| 220 | -34.70 | -35.54 | -36.40 | -37.29 | -38.18 |
| 230 | -39.10 | -40.04 | -41.00 | -41.98 | -42.98 |
| 240 | -44.00 | -45.05 | -46.12 | -47.21 | -48.33 |
| 250 | -49.47 | -50.64 | -51.83 | -53.05 |        |

DEG C

RUN 0327 0012CRS

FRAME 29

MJS77 SERIAL NO..... MJS-2  
MJS77 FUNCTION ..... LET D TEMPERATURE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 2

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 001

MEAS CALIB RANGE ... +40 TO -50 DEG C  
MEAS CALIB TEMP .... N/A

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ...  
XDUCER CALIB DATE .. 28 JUN 76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0327 0012CRS

STANDARD DEVIATION . .44052282+00

COEFFICIENT A0 ..... .68213680+02  
COEFFICIENT A1 ..... -.10653336+01  
COEFFICIENT A2 ..... .54026245-02  
COEFFICIENT A3 ..... -.12564523-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.77        | 39.4195       | .580482  |
| 30.00           | 44.18        | 30.6118       | -.611827 |
| 20.00           | 61.00        | 20.4783       | -.478338 |
| 10.00           | 83.27        | 9.7110        | .289042  |
| .00             | 110.63       | -.5346        | .534564  |
| -10.00          | 141.57       | -9.9747       | -.025333 |
| -20.00          | 173.18       | -19.5076      | -.492360 |
| -30.00          | 201.56       | -29.9138      | -.086203 |
| -40.00          | 224.00       | -40.5565      | .556492  |
| -50.00          | 239.64       | -49.7335      | -.266509 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      |
|-----|--------|--------|--------|--------|--------|
| 0   | 68.21  | 66.10  | 64.04  | 62.01  | 60.03  |
| 10  | 58.09  | 56.19  | 54.32  | 52.50  | 50.71  |
| 20  | 48.97  | 47.26  | 45.58  | 43.95  | 42.34  |
| 30  | 40.78  | 39.24  | 37.74  | 36.28  | 34.84  |
| 40  | 33.44  | 32.07  | 30.73  | 29.42  | 28.14  |
| 50  | 26.88  | 25.66  | 24.46  | 23.29  | 22.15  |
| 60  | 21.03  | 19.94  | 18.87  | 17.82  | 16.80  |
| 70  | 15.80  | 14.83  | 13.87  | 12.94  | 12.02  |
| 80  | 11.13  | 10.26  | 9.40   | 8.56   | 7.74   |
| 90  | 6.94   | 6.15   | 5.37   | 4.62   | 3.87   |
| 100 | 3.14   | 2.42   | 1.72   | 1.03   | .35    |
| 110 | -.32   | -.99   | -1.64  | -2.28  | -2.91  |
| 120 | -3.54  | -4.16  | -4.77  | -5.38  | -5.98  |
| 130 | -6.58  | -7.17  | -7.76  | -8.35  | -8.94  |
| 140 | -9.52  | -10.10 | -10.68 | -11.27 | -11.85 |
| 150 | -12.43 | -13.02 | -13.61 | -14.20 | -14.80 |
| 160 | -15.40 | -16.00 | -16.61 | -17.23 | -17.86 |
| 170 | -18.49 | -19.13 | -19.77 | -20.43 | -21.10 |
| 180 | -21.78 | -22.47 | -23.17 | -23.88 | -24.61 |
| 190 | -25.35 | -26.10 | -26.87 | -27.65 | -28.45 |
| 200 | -29.26 | -30.10 | -30.95 | -31.82 | -32.70 |
| 210 | -33.61 | -34.54 | -35.49 | -36.45 | -37.45 |
| 220 | -38.46 | -39.50 | -40.56 | -41.64 | -42.75 |
| 230 | -43.89 | -45.05 | -46.24 | -47.45 | -48.70 |
| 240 | -49.97 | -51.27 | -52.60 | -53.96 | -55.35 |
| 250 | -56.78 | -58.23 | -59.72 | -61.24 |        |

DEG C

RUN 0327 0012CRS

MJS77 SERIAL NO..... MJS-2  
MJS77 FUNCTION ..... HET A TEMPERATURE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 2

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 001

MEAS CALIB RANGE ... +40 TO -50 DEG C  
MEAS CALIB TEMP .... N/A

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ...  
XDUCER CALIB DATE .. 28 JUN 76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0327 0012CRS

STANDARD DEVIATION . .44052282+00

COEFFICIENT A0 ..... .68213680+02  
COEFFICIENT A1 ..... -.10653336+01  
COEFFICIENT A2 ..... .54026245-02  
COEFFICIENT A3 ..... -.12564523-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.77        | 39.4195       | .580482  |
| 30.00           | 44.18        | 30.6118       | -.611827 |
| 20.00           | 61.00        | 20.4783       | -.478338 |
| 10.00           | 83.27        | 9.7110        | .289042  |
| .00             | 110.63       | -.5346        | .534564  |
| -10.00          | 141.57       | -9.9747       | -.025333 |
| -20.00          | 173.18       | -19.5076      | -.492360 |
| -30.00          | 201.56       | -29.9138      | -.086203 |
| -40.00          | 224.00       | -40.5565      | .556492  |
| -50.00          | 239.64       | -49.7335      | -.266509 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      |
|-----|--------|--------|--------|--------|--------|
| 0   | 68.21  | 66.10  | 64.04  | 62.01  | 60.03  |
| 10  | 58.09  | 56.19  | 54.32  | 52.50  | 50.71  |
| 20  | 48.97  | 47.26  | 45.58  | 43.95  | 42.34  |
| 30  | 40.78  | 39.24  | 37.74  | 36.28  | 34.84  |
| 40  | 33.44  | 32.07  | 30.73  | 29.42  | 28.14  |
| 50  | 26.88  | 25.66  | 24.46  | 23.29  | 22.15  |
| 60  | 21.03  | 19.94  | 18.87  | 17.82  | 16.80  |
| 70  | 15.80  | 14.83  | 13.87  | 12.94  | 12.02  |
| 80  | 11.13  | 10.26  | 9.40   | 8.56   | 7.74   |
| 90  | 6.94   | 6.15   | 5.37   | 4.62   | 3.87   |
| 100 | 3.14   | 2.42   | 1.72   | 1.03   | .36    |
| 110 | -.32   | -.99   | -1.64  | -2.28  | -2.91  |
| 120 | -3.54  | -4.16  | -4.77  | -5.38  | -5.98  |
| 130 | -6.58  | -7.17  | -7.76  | -8.35  | -8.94  |
| 140 | -9.52  | -10.10 | -10.68 | -11.27 | -11.85 |
| 150 | -12.43 | -13.02 | -13.61 | -14.20 | -14.80 |
| 160 | -15.40 | -16.00 | -16.61 | -17.23 | -17.86 |
| 170 | -18.49 | -19.13 | -19.77 | -20.43 | -21.10 |
| 180 | -21.78 | -22.47 | -23.17 | -23.88 | -24.61 |
| 190 | -25.35 | -26.10 | -26.87 | -27.65 | -28.45 |
| 200 | -29.26 | -30.10 | -30.95 | -31.82 | -32.70 |
| 210 | -33.61 | -34.54 | -35.49 | -36.45 | -37.45 |
| 220 | -38.46 | -39.50 | -40.56 | -41.64 | -42.75 |
| 230 | -43.89 | -45.05 | -46.24 | -47.45 | -48.70 |
| 240 | -49.97 | -51.27 | -52.60 | -53.96 | -55.35 |
| 250 | -56.78 | -58.23 | -59.72 | -61.24 |        |

DEG C

RUN 0327 0012CRS

MJS77 SERIAL NO.....MJS-2  
MJS77 FUNCTION ..... HET B TEMPERATURE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 2

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 001

MEAS CALIB RANGE ... +40 TO -50 DEG C  
MEAS CALIB TEMP .... N/A

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ...  
XDUCER CALIB DATE .. 28 JUN 76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0327 0012CRS

STANDARD DEVIATION . .44052282+00

COEFFICIENT A0 ..... .68213680+02  
COEFFICIENT A1 ..... -.10653336+01  
COEFFICIENT A2 ..... .54026245-02  
COEFFICIENT A3 ..... -.12564523-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.77        | 39.4195       | .580482  |
| 30.00           | 44.18        | 30.6118       | -.611827 |
| 20.00           | 61.00        | 20.4783       | -.478338 |
| 10.00           | 83.27        | 9.7110        | .289042  |
| .00             | 110.63       | -.5346        | .534564  |
| -10.00          | 141.57       | -9.9747       | -.025333 |
| -20.00          | 173.18       | -19.5076      | -.492360 |
| -30.00          | 201.56       | -29.9138      | -.086203 |
| -40.00          | 224.00       | -40.5565      | .556492  |
| -50.00          | 239.64       | -49.7335      | -.266509 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      |
|-----|--------|--------|--------|--------|--------|
| 0   | 68.21  | 66.10  | 64.04  | 62.01  | 60.03  |
| 10  | 58.09  | 56.19  | 54.32  | 52.50  | 50.71  |
| 20  | 48.97  | 47.26  | 45.58  | 43.95  | 42.34  |
| 30  | 40.78  | 39.24  | 37.74  | 36.28  | 34.84  |
| 40  | 33.44  | 32.07  | 30.73  | 29.42  | 28.14  |
| 50  | 26.88  | 25.66  | 24.46  | 23.29  | 22.15  |
| 60  | 21.03  | 19.94  | 18.87  | 17.82  | 16.80  |
| 70  | 15.80  | 14.83  | 13.87  | 12.94  | 12.02  |
| 80  | 11.13  | 10.26  | 9.40   | 8.56   | 7.74   |
| 90  | 6.94   | 6.15   | 5.37   | 4.62   | 3.87   |
| 100 | 3.14   | 2.42   | 1.72   | 1.03   | .35    |
| 110 | -.32   | -.99   | -1.64  | -2.28  | -2.91  |
| 120 | -3.54  | -4.16  | -4.77  | -5.38  | -5.98  |
| 130 | -6.58  | -7.17  | -7.76  | -8.35  | -8.94  |
| 140 | -9.52  | -10.10 | -10.68 | -11.27 | -11.85 |
| 150 | -12.43 | -13.02 | -13.61 | -14.20 | -14.80 |
| 160 | -15.40 | -16.00 | -16.61 | -17.23 | -17.86 |
| 170 | -18.49 | -19.13 | -19.77 | -20.43 | -21.10 |
| 180 | -21.78 | -22.47 | -23.17 | -23.88 | -24.61 |
| 190 | -25.35 | -26.10 | -26.87 | -27.65 | -28.45 |
| 200 | -29.26 | -30.10 | -30.95 | -31.82 | -32.70 |
| 210 | -33.61 | -34.54 | -35.49 | -36.45 | -37.45 |
| 220 | -38.46 | -39.50 | -40.56 | -41.64 | -42.75 |
| 230 | -43.89 | -45.05 | -46.24 | -47.45 | -48.70 |
| 240 | -49.97 | -51.27 | -52.60 | -53.96 | -55.35 |
| 250 | -56.78 | -58.23 | -59.72 | -61.24 |        |

DEG C

RUN 0327 0012CRS

MJS77 SERIAL NO..... MJS-2  
MJS77 FUNCTION ..... TET TEMPERATURE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 2

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 001

MEAS CALIB RANGE ... +40 TO -50 DEG C  
MEAS CALIB TEMP .... N/A

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ...  
XDUCER CALIB DATE .. 28 JUN 76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0327 0012CRS

STANDARD DEVIATION . .44052282+00

COEFFICIENT A0 ..... .68213680+02  
COEFFICIENT A1 ..... -.10653336+01  
COEFFICIENT A2 ..... .54026245-02  
COEFFICIENT A3 ..... -.12564523-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.77        | 39.4195       | .580482  |
| 30.00           | 44.18        | 30.6118       | -.611827 |
| 20.00           | 61.00        | 20.4783       | -.478338 |
| 10.00           | 83.27        | 9.7110        | .289042  |
| .00             | 110.63       | -.5346        | .534564  |
| -10.00          | 141.57       | -9.9747       | -.025333 |
| -20.00          | 173.18       | -19.5076      | -.492360 |
| -30.00          | 201.56       | -29.9138      | -.086203 |
| -40.00          | 224.00       | -40.5565      | .556492  |
| -50.00          | 239.64       | -49.7335      | -.266509 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | FRAME 41<br>8 |
|-----|--------|--------|--------|--------|---------------|
| 0   | 68.21  | 66.10  | 64.04  | 62.01  | 60.03         |
| 10  | 58.09  | 56.19  | 54.32  | 52.50  | 50.71         |
| 20  | 48.97  | 47.26  | 45.58  | 43.95  | 42.34         |
| 30  | 40.78  | 39.24  | 37.74  | 36.28  | 34.84         |
| 40  | 33.44  | 32.07  | 30.73  | 29.42  | 28.14         |
| 50  | 26.88  | 25.66  | 24.46  | 23.29  | 22.15         |
| 60  | 21.03  | 19.94  | 18.87  | 17.82  | 16.80         |
| 70  | 15.80  | 14.83  | 13.87  | 12.94  | 12.02         |
| 80  | 11.13  | 10.26  | 9.40   | 8.56   | 7.74          |
| 90  | 6.94   | 6.15   | 5.37   | 4.62   | 3.87          |
| 100 | 3.14   | 2.42   | 1.72   | 1.03   | .35           |
| 110 | -.32   | -.99   | -1.64  | -2.28  | -2.91         |
| 120 | -3.54  | -4.16  | -4.77  | -5.38  | -5.98         |
| 130 | -6.58  | -7.17  | -7.76  | -8.35  | -8.94         |
| 140 | -9.52  | -10.10 | -10.68 | -11.27 | -11.85        |
| 150 | -12.43 | -13.02 | -13.61 | -14.20 | -14.80        |
| 160 | -15.40 | -16.00 | -16.61 | -17.23 | -17.86        |
| 170 | -18.49 | -19.13 | -19.77 | -20.43 | -21.10        |
| 180 | -21.78 | -22.47 | -23.17 | -23.88 | -24.61        |
| 190 | -25.35 | -26.10 | -26.87 | -27.65 | -28.45        |
| 200 | -29.26 | -30.10 | -30.95 | -31.82 | -32.70        |
| 210 | -33.61 | -34.54 | -35.49 | -36.45 | -37.45        |
| 220 | -38.46 | -39.50 | -40.56 | -41.64 | -42.75        |
| 230 | -43.89 | -45.05 | -46.24 | -47.45 | -48.70        |
| 240 | -49.97 | -51.27 | -52.60 | -53.96 | -55.35        |
| 250 | -56.78 | -58.23 | -59.72 | -61.24 |               |

DEG C

RUN 0327 0012CRS

MJS77 SERIAL NO..... MJS-2  
MJS77 FUNCTION ..... POWER CONVERTER TEMPERATURE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS.  
FDS SERIAL NO..... 2

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 001

MEAS CALIB RANGE ... +40 TO -50 DEG C  
MEAS CALIB TEMP .... N/A

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ...  
XDUCER CALIB DATE .. 28 JUN 76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0327 0012CRS

STANDARD DEVIATION . .32808928\*01

COEFFICIENT A0 ..... .70640766\*02  
COEFFICIENT A1 ..... -.11466025\*01  
COEFFICIENT A2 ..... .60449678-02  
COEFFICIENT A3 ..... -.13720321-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA     |
|-----------------|--------------|---------------|-----------|
| 40.00           | 31.77        | 39.8760       | .123954   |
| 30.00           | 44.18        | 30.6027       | -.602692  |
| 20.00           | 61.00        | 20.0758       | -.075802  |
| 10.00           | 83.27        | 9.1574        | .842620   |
| .00             | 110.63       | -.8015        | .801526   |
| -10.00          | 141.57       | -9.4565       | -.541534  |
| -20.00          | 173.18       | -17.8931      | -2.106907 |
| -30.00          | 227.06       | -38.6652      | 8.665201  |
| -40.00          | 224.00       | -37.0939      | -2.906052 |
| -50.00          | 239.64       | -45.7997      | -4.200312 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      | FRAME 45 |
|-----|--------|--------|--------|--------|--------|----------|
| 0   | 70.64  | 68.37  | 66.15  | 63.98  | 61.85  |          |
| 10  | 59.77  | 57.73  | 55.74  | 53.79  | 51.88  |          |
| 20  | 50.02  | 48.20  | 46.41  | 44.67  | 42.97  |          |
| 30  | 41.31  | 39.69  | 38.11  | 36.56  | 35.05  |          |
| 40  | 33.57  | 32.13  | 30.72  | 29.35  | 28.01  |          |
| 50  | 26.71  | 25.43  | 24.19  | 22.98  | 21.80  |          |
| 60  | 20.64  | 19.52  | 18.42  | 17.35  | 16.31  |          |
| 70  | 15.29  | 14.30  | 13.33  | 12.39  | 11.47  |          |
| 80  | 10.58  | 9.70   | 8.85   | 8.01   | 7.20   |          |
| 90  | 6.41   | 5.63   | 4.88   | 4.14   | 3.42   |          |
| 100 | 2.71   | 2.02   | 1.34   | .68    | .03    |          |
| 110 | -.60   | -1.23  | -1.84  | -2.44  | -3.03  |          |
| 120 | -3.61  | -4.19  | -4.75  | -5.31  | -5.86  |          |
| 130 | -6.40  | -6.94  | -7.47  | -8.00  | -8.53  |          |
| 140 | -9.05  | -9.57  | -10.09 | -10.61 | -11.13 |          |
| 150 | -11.64 | -12.16 | -12.68 | -13.21 | -13.73 |          |
| 160 | -14.26 | -14.80 | -15.34 | -15.88 | -16.43 |          |
| 170 | -16.99 | -17.56 | -18.13 | -18.71 | -19.30 |          |
| 180 | -19.91 | -20.52 | -21.15 | -21.78 | -22.43 |          |
| 190 | -23.10 | -23.78 | -24.47 | -25.18 | -25.90 |          |
| 200 | -26.64 | -27.40 | -28.18 | -28.98 | -29.79 |          |
| 210 | -30.63 | -31.48 | -32.36 | -33.26 | -34.18 |          |
| 220 | -35.13 | -36.10 | -37.09 | -38.11 | -39.16 |          |
| 230 | -40.23 | -41.33 | -42.46 | -43.62 | -44.81 |          |
| 240 | -46.02 | -47.27 | -48.55 | -49.86 | -51.20 |          |
| 250 | -52.58 | -53.99 | -55.43 | -56.92 |        |          |

DEG C

RUN 0327 0012CRS

MJS77 SERIAL NO..... MJS-2  
MJS77 FUNCTION ..... BASEPLATE TEMPERATURE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 2

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 001

MEAS CALIB RANGE ... +40 TO -50 DEG C  
MEAS CALIB TEMP .... N/A

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ...  
XDUCER CALIB DATE .. 28 JUN 76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0327 0012CRS

STANDARD DEVIATION . .44052282+00

COEFFICIENT A0 ..... .68213680+02  
COEFFICIENT A1 ..... -.10653336+01  
COEFFICIENT A2 ..... .54026245-02  
COEFFICIENT A3 ..... -.12564523-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.77        | 39.4195       | .580482  |
| 30.00           | 44.18        | 30.6118       | -.611827 |
| 20.00           | 61.00        | 20.4783       | -.478338 |
| 10.00           | 83.27        | 9.7110        | .289042  |
| .00             | 110.63       | -.5346        | .534564  |
| -10.00          | 141.57       | -9.9747       | -.025333 |
| -20.00          | 173.18       | -19.5076      | -.492360 |
| -30.00          | 201.56       | -29.9138      | -.086203 |
| -40.00          | 224.00       | -40.5565      | .556492  |
| -50.00          | 239.64       | -49.7335      | -.266509 |

DATA NUMBER

|     | FRAME 49 |        |        |        |        |
|-----|----------|--------|--------|--------|--------|
|     | 0        | 2      | 4      | 6      | 8      |
| 0   | 68.21    | 66.10  | 64.04  | 62.01  | 60.03  |
| 10  | 58.09    | 56.19  | 54.32  | 52.50  | 50.71  |
| 20  | 48.97    | 47.26  | 45.58  | 43.95  | 42.34  |
| 30  | 40.78    | 39.24  | 37.74  | 36.28  | 34.84  |
| 40  | 33.44    | 32.07  | 30.73  | 29.42  | 28.14  |
| 50  | 26.88    | 25.66  | 24.46  | 23.29  | 22.15  |
| 60  | 21.03    | 19.94  | 18.87  | 17.82  | 16.80  |
| 70  | 15.80    | 14.83  | 13.87  | 12.94  | 12.02  |
| 80  | 11.13    | 10.26  | 9.40   | 8.56   | 7.74   |
| 90  | 6.94     | 6.15   | 5.37   | 4.62   | 3.87   |
| 100 | 3.14     | 2.42   | 1.72   | 1.03   | .35    |
| 110 | -.32     | -.99   | -1.64  | -2.28  | -2.91  |
| 120 | -3.54    | -4.16  | -4.77  | -5.38  | -5.98  |
| 130 | -6.58    | -7.17  | -7.76  | -8.35  | -8.94  |
| 140 | -9.52    | -10.10 | -10.68 | -11.27 | -11.85 |
| 150 | -12.43   | -13.02 | -13.61 | -14.20 | -14.80 |
| 160 | -15.40   | -16.00 | -16.61 | -17.23 | -17.86 |
| 170 | -18.49   | -19.13 | -19.77 | -20.43 | -21.10 |
| 180 | -21.78   | -22.47 | -23.17 | -23.88 | -24.61 |
| 190 | -25.35   | -26.10 | -26.87 | -27.65 | -28.45 |
| 200 | -29.26   | -30.10 | -30.95 | -31.82 | -32.70 |
| 210 | -33.61   | -34.54 | -35.49 | -36.45 | -37.45 |
| 220 | -38.46   | -39.50 | -40.56 | -41.64 | -42.75 |
| 230 | -43.89   | -45.05 | -46.24 | -47.45 | -48.70 |
| 240 | -49.97   | -51.27 | -52.60 | -53.96 | -55.35 |
| 250 | -56.78   | -58.23 | -59.72 | -61.24 |        |

DEG C

RUN 0407 0022CRS

MJS77 SERIAL NO..... MJS-2  
MJS77 FUNCTION ..... PHA ELECTRONICS TEMPERATURE  
FDS TPEESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 2

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 002

MEAS CALIB RANGE ... +50 TO -50 DEG C  
MEAS CALIB TEMP .... -

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ... -  
XDUCER CALIB DATE .. 28 JUN 76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0407 0022CRS

STANDARD DEVIATION . .44052282+00

COEFFICIENT A0 ..... .68213680+02  
COEFFICIENT A1 ..... -.10653336+01  
COEFFICIENT A2 ..... .54026245-02  
COEFFICIENT A3 ..... -.12564523-04

| MEASURAND<br>EU | OUTPUT<br>CN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.77        | 39.4195       | .580482  |
| 30.00           | 44.18        | 30.6118       | -.611827 |
| 20.00           | 61.00        | 20.4783       | -.478338 |
| 10.00           | 83.27        | 9.7110        | .289042  |
| .00             | 110.63       | -.5346        | .534564  |
| -10.00          | 141.57       | -9.9747       | -.025333 |
| -20.00          | 173.18       | -19.5076      | -.492360 |
| -30.00          | 201.56       | -29.9138      | -.086203 |
| -40.00          | 224.00       | -40.5565      | .556492  |
| -50.00          | 239.64       | -49.7335      | -.266509 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      |
|-----|--------|--------|--------|--------|--------|
| 0   | 68.21  | 66.10  | 64.04  | 62.01  | 60.03  |
| 10  | 58.09  | 56.19  | 54.32  | 52.50  | 50.71  |
| 20  | 48.97  | 47.26  | 45.58  | 43.95  | 42.34  |
| 30  | 40.78  | 39.24  | 37.74  | 36.28  | 34.84  |
| 40  | 33.44  | 32.07  | 30.73  | 29.42  | 28.14  |
| 50  | 26.88  | 25.66  | 24.46  | 23.29  | 22.15  |
| 60  | 21.03  | 19.94  | 18.87  | 17.82  | 16.80  |
| 70  | 15.80  | 14.83  | 13.87  | 12.94  | 12.02  |
| 80  | 11.13  | 10.26  | 9.40   | 8.56   | 7.74   |
| 90  | 6.94   | 6.15   | 5.37   | 4.62   | 3.87   |
| 100 | 3.14   | 2.42   | 1.72   | 1.03   | .35    |
| 110 | -.32   | -.99   | -1.64  | -2.28  | -2.91  |
| 120 | -3.54  | -4.16  | -4.77  | -5.38  | -5.98  |
| 130 | -6.58  | -7.17  | -7.76  | -8.35  | -8.94  |
| 140 | -9.52  | -10.10 | -10.68 | -11.27 | -11.85 |
| 150 | -12.43 | -13.02 | -13.61 | -14.20 | -14.80 |
| 160 | -15.40 | -16.00 | -16.61 | -17.23 | -17.86 |
| 170 | -18.49 | -19.13 | -19.77 | -20.43 | -21.10 |
| 180 | -21.78 | -22.47 | -23.17 | -23.88 | -24.61 |
| 190 | -25.35 | -26.10 | -26.87 | -27.65 | -28.45 |
| 200 | -29.26 | -30.10 | -30.95 | -31.82 | -32.70 |
| 210 | -33.61 | -34.54 | -35.49 | -36.45 | -37.45 |
| 220 | -38.46 | -39.50 | -40.56 | -41.64 | -42.75 |
| 230 | -43.89 | -45.05 | -46.24 | -47.45 | -48.70 |
| 240 | -49.97 | -51.27 | -52.60 | -53.96 | -55.35 |
| 250 | -56.78 | -58.23 | -59.72 | -61.24 |        |

DEG C

RUN 0597 0022CRS

MJS77 SERIAL NO..... MJS-2  
MJS77 FUNCTION ..... CRS SUPP/REPL HEATER A TEMP

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 2

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 002

MEAS CALIB RANGE ... +40 TO -50 DEG C  
MEAS CALIB TEMP .... -

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ... -  
XDUCER CALIB DATE .. 28 JUN 76

DATA PREPARED BY ... GSCF  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0597 0022CRS

STANDARD DEVIATION . .44052202+00

COEFFICIENT A0 ..... .68213680+02  
COEFFICIENT A1 ..... -.10653336+01  
COEFFICIENT A2 ..... .54026245-02  
COEFFICIENT A3 ..... -.12564523-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.77        | 39.4195       | .580482  |
| 30.00           | 44.18        | 30.6118       | -.611827 |
| 20.00           | 61.00        | 20.4783       | -.478338 |
| 10.00           | 83.27        | 9.7110        | .289042  |
| .00             | 110.63       | -.5346        | .534564  |
| -10.00          | 141.57       | -9.9747       | -.025333 |
| -20.00          | 173.18       | -19.5076      | -.492360 |
| -30.00          | 201.56       | -29.9138      | -.086203 |
| -40.00          | 224.00       | -40.5565      | .556492  |
| -50.00          | 239.64       | -49.7335      | -.266509 |

DATA NUMBER

|     | FRAME 25 |        |        |        |        |
|-----|----------|--------|--------|--------|--------|
|     | 0        | 2      | 4      | 6      | 8      |
| 0   | 68.21    | 66.10  | 64.04  | 62.01  | 60.03  |
| 10  | 58.09    | 56.19  | 54.32  | 52.50  | 50.71  |
| 20  | 48.97    | 47.26  | 45.58  | 43.95  | 42.34  |
| 30  | 40.78    | 39.24  | 37.74  | 36.28  | 34.84  |
| 40  | 33.44    | 32.07  | 30.73  | 29.42  | 28.14  |
| 50  | 26.88    | 25.66  | 24.46  | 23.29  | 22.15  |
| 60  | 21.03    | 19.94  | 18.87  | 17.82  | 16.80  |
| 70  | 15.80    | 14.83  | 13.87  | 12.94  | 12.02  |
| 80  | 11.13    | 10.26  | 9.40   | 8.56   | 7.74   |
| 90  | 6.94     | 6.15   | 5.37   | 4.62   | 3.87   |
| 100 | 3.14     | 2.42   | 1.72   | 1.03   | .35    |
| 110 | -.32     | -.99   | -1.64  | -2.28  | -2.91  |
| 120 | -3.54    | -4.16  | -4.77  | -5.38  | -5.98  |
| 130 | -6.58    | -7.17  | -7.76  | -8.35  | -8.94  |
| 140 | -9.52    | -10.10 | -10.68 | -11.27 | -11.85 |
| 150 | -12.43   | -13.02 | -13.61 | -14.20 | -14.80 |
| 160 | -15.40   | -16.00 | -16.61 | -17.23 | -17.86 |
| 170 | -18.49   | -19.13 | -19.77 | -20.43 | -21.10 |
| 180 | -21.78   | -22.47 | -23.17 | -23.88 | -24.61 |
| 190 | -25.35   | -26.10 | -26.87 | -27.65 | -28.45 |
| 200 | -29.26   | -30.10 | -30.95 | -31.82 | -32.70 |
| 210 | -33.61   | -34.54 | -35.49 | -36.45 | -37.45 |
| 220 | -38.46   | -39.50 | -40.56 | -41.64 | -42.75 |
| 230 | -43.89   | -45.05 | -46.24 | -47.45 | -48.70 |
| 240 | -49.97   | -51.27 | -52.60 | -53.96 | -55.35 |
| 250 | -56.78   | -58.23 | -59.72 | -61.24 |        |

DEG C

RUN 0597 0022CRS

MJS77 SERIAL NO..... MJS-2  
MJS77 FUNCTION ..... CRS SUPP/REPL HEATER B TEMP

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 2

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 002

MEAS CALIB RANGE ... +40 TO -50 DEG C  
MEAS CALIB TEMP .... -

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE .... -  
XDUCER CALIB DATE .. 28 JUN 76

DATA PREPARED BY ... GSCF  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0597 0022CRS

STANDARD DEVIATION . .44052282+00

COEFFICIENT A0 ..... .68213680+02  
COEFFICIENT A1 ..... -.10653336+01  
COEFFICIENT A2 ..... .54026245-02  
COEFFICIENT A3 ..... -.12564523-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.77        | 39.4195       | .580482  |
| 30.00           | 44.18        | 30.6118       | -.611827 |
| 20.00           | 61.00        | 20.4783       | -.478338 |
| 10.00           | 83.27        | 9.7110        | .289042  |
| .00             | 110.63       | -.5346        | .534564  |
| -10.00          | 141.57       | -9.9747       | -.025333 |
| -20.00          | 173.18       | -19.5076      | -.492360 |
| -30.00          | 201.56       | -29.9138      | -.086203 |
| -40.00          | 224.00       | -40.5565      | .556492  |
| -50.00          | 239.64       | -49.7335      | -.266509 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      | 21 |
|-----|--------|--------|--------|--------|--------|----|
| 0   | 68.21  | 66.10  | 64.04  | 62.01  | 60.03  |    |
| 10  | 58.09  | 56.19  | 54.32  | 52.50  | 50.71  |    |
| 20  | 48.97  | 47.26  | 45.58  | 43.95  | 42.34  |    |
| 30  | 40.78  | 39.24  | 37.74  | 36.28  | 34.84  |    |
| 40  | 33.44  | 32.07  | 30.73  | 29.42  | 28.14  |    |
| 50  | 26.88  | 25.66  | 24.46  | 23.29  | 22.15  |    |
| 60  | 21.03  | 19.94  | 18.87  | 17.82  | 16.80  |    |
| 70  | 15.80  | 14.83  | 13.87  | 12.94  | 12.02  |    |
| 80  | 11.13  | 10.26  | 9.40   | 8.56   | 7.74   |    |
| 90  | 6.94   | 6.15   | 5.37   | 4.62   | 3.87   |    |
| 100 | 3.14   | 2.42   | 1.72   | 1.03   | .35    |    |
| 110 | -.32   | -.99   | -1.64  | -2.28  | -2.91  |    |
| 120 | -3.54  | -4.16  | -4.77  | -5.38  | -5.98  |    |
| 130 | -6.58  | -7.17  | -7.76  | -8.35  | -8.94  |    |
| 140 | -9.52  | -10.10 | -10.68 | -11.27 | -11.85 |    |
| 150 | -12.43 | -13.02 | -13.61 | -14.20 | -14.80 |    |
| 160 | -15.40 | -16.00 | -16.61 | -17.23 | -17.86 |    |
| 170 | -18.49 | -19.13 | -19.77 | -20.43 | -21.10 |    |
| 180 | -21.78 | -22.47 | -23.17 | -23.88 | -24.61 |    |
| 190 | -25.35 | -26.10 | -26.87 | -27.65 | -28.45 |    |
| 200 | -29.26 | -30.10 | -30.95 | -31.82 | -32.70 |    |
| 210 | -33.61 | -34.54 | -35.49 | -36.45 | -37.45 |    |
| 220 | -38.46 | -39.50 | -40.56 | -41.64 | -42.75 |    |
| 230 | -43.89 | -45.05 | -46.24 | -47.45 | -48.70 |    |
| 240 | -49.97 | -51.27 | -52.60 | -53.96 | -55.35 |    |
| 250 | -56.78 | -58.23 | -59.72 | -61.24 |        |    |

DEG C

RUN 0737 0031CRS

MJS77 SERIAL NO..... MJS-3  
MJS77 FUNCTION ..... CRS ELECTRONICS TEMP

FDS TREESWITCH ID .. 57  
FDS RANGE ..... 350-700 OHMS  
FDS SERIAL NO..... 1

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 003

MEAS CALIB RANGE ... -80 TO 100 DEG C  
MEAS CALIB TEMP .... -

XDUCER SERIAL NO.... K006  
XDUCER IMPEDANCE ... -  
XDUCER CALIB DATE .. 10/9/74

DATA PREPARED BY ... ROSEMONT ENG  
APPROVED BY ... JPL  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0737 0031CRS

STANDARD DEVIATION . .42138135+00

COEFFICIENT A0 ..... -.77857590+02  
COEFFICIENT A1 ..... .70578162+00

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| -80.00          | -4.23        | -80.8412      | .841199  |
| -70.00          | 10.37        | -70.5360      | .536033  |
| -60.00          | 24.90        | -60.2818      | .281783  |
| -50.00          | 39.37        | -50.0683      | .068265  |
| -40.00          | 53.79        | -39.8955      | -.104521 |
| -30.00          | 68.15        | -29.7583      | -.241669 |
| -20.00          | 82.46        | -19.6568      | -.343173 |
| -10.00          | 96.74        | -9.5808       | -.419222 |
| .00             | 110.96       | .4545         | -.454538 |
| 10.00           | 125.14       | 10.4644       | -.464399 |
| 20.00           | 139.28       | 20.4437       | -.443707 |
| 30.00           | 153.38       | 30.3976       | -.397562 |
| 40.00           | 167.44       | 40.3158       | -.315772 |
| 50.00           | 181.45       | 50.2034       | -.203434 |
| 60.00           | 195.42       | 60.0656       | -.065642 |
| 70.00           | 209.35       | 69.8973       | .102702  |
| 80.00           | 223.24       | 79.6984       | .301595  |
| 90.00           | 237.08       | 89.4690       | .531034  |
| 100.00          | 250.88       | 99.2090       | .791024  |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      |
|-----|--------|--------|--------|--------|--------|
| 0   | -77.86 | -76.45 | -75.03 | -73.62 | -72.21 |
| 10  | -70.80 | -69.39 | -67.98 | -66.57 | -65.15 |
| 20  | -63.74 | -62.33 | -60.92 | -59.51 | -58.10 |
| 30  | -56.68 | -55.27 | -53.86 | -52.45 | -51.04 |
| 40  | -49.63 | -48.21 | -46.80 | -45.39 | -43.98 |
| 50  | -42.57 | -41.16 | -39.75 | -38.33 | -36.92 |
| 60  | -35.51 | -34.10 | -32.69 | -31.28 | -29.86 |
| 70  | -28.45 | -27.04 | -25.63 | -24.22 | -22.81 |
| 80  | -21.40 | -19.98 | -18.57 | -17.16 | -15.75 |
| 90  | -14.34 | -12.93 | -11.51 | -10.10 | -8.69  |
| 100 | -7.28  | -5.87  | -4.46  | -3.04  | -1.63  |
| 110 | -.22   | 1.19   | 2.60   | 4.01   | 5.42   |
| 120 | 6.84   | 8.25   | 9.66   | 11.07  | 12.48  |
| 130 | 13.89  | 15.31  | 16.72  | 18.13  | 19.54  |
| 140 | 20.95  | 22.36  | 23.77  | 25.19  | 26.60  |
| 150 | 28.01  | 29.42  | 30.83  | 32.24  | 33.66  |
| 160 | 35.07  | 36.48  | 37.89  | 39.30  | 40.71  |
| 170 | 42.13  | 43.54  | 44.95  | 46.36  | 47.77  |
| 180 | 49.18  | 50.59  | 52.01  | 53.42  | 54.83  |
| 190 | 56.24  | 57.65  | 59.06  | 60.48  | 61.89  |
| 200 | 63.30  | 64.71  | 66.12  | 67.53  | 68.94  |
| 210 | 70.36  | 71.77  | 73.18  | 74.59  | 76.00  |
| 220 | 77.41  | 78.83  | 80.24  | 81.65  | 83.06  |
| 230 | 84.47  | 85.88  | 87.30  | 88.71  | 90.12  |
| 240 | 91.53  | 92.94  | 94.35  | 95.76  | 97.18  |
| 250 | 98.59  | 100.00 | 101.41 | 102.82 |        |

DEG C

E-361

CRS EL T

Chg 1, 10 May 77

RUN 0737 0031CRS

FRAME 23  
8

MJS77 SERIAL NO..... MJS-3  
MJS77 FUNCTION ..... CRS TELESCOPE TEMP  
FDS TREESWITCH ID .. 07  
FDS RANGE ..... 350-700 OHMS  
FDS SERIAL NO..... 1  
SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 003  
MEAS CALIB RANGE ... -80 TO 100 DEG C  
MEAS CALIB TEMP .... -  
XDUCER SERIAL NO.... K007  
XDUCER IMPEDANCE ... -  
XDUCER CALIB DATE .. 10/9/74

DATA PREPARED BY ... ROSEMONT ENG  
APPROVED BY ... JPL  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0737 0031CRS

STANDARD DEVIATION . .40389425+00

COEFFICIENT A0 ..... -.79689597+02  
COEFFICIENT A1 ..... .70239450+00

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| -80.00          | -1.61        | -80.8216      | .821590  |
| -70.00          | 13.06        | -70.5169      | .516894  |
| -60.00          | 27.66        | -60.2630      | .262960  |
| -50.00          | 42.18        | -50.0598      | .059789  |
| -40.00          | 56.66        | -39.8922      | -.107849 |
| -30.00          | 71.08        | -29.7600      | -.239956 |
| -20.00          | 85.46        | -19.6635      | -.336527 |
| -10.00          | 99.78        | -9.6024       | -.397566 |
| .00             | 114.08       | .4383         | -.438299 |
| 10.00           | 128.32       | 10.4435       | -.443498 |
| 20.00           | 142.53       | 20.4233       | -.423320 |
| 30.00           | 156.70       | 30.3727       | -.372681 |
| 40.00           | 170.82       | 40.2967       | -.296662 |
| 50.00           | 184.91       | 50.1902       | -.190186 |
| 60.00           | 198.96       | 60.0583       | -.058325 |
| 70.00           | 212.97       | 69.9011       | .098909  |
| 80.00           | 226.94       | 79.7083       | .291680  |
| 90.00           | 240.87       | 89.4952       | .504758  |
| 100.00          | 254.76       | 99.2517       | .748291  |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      |
|-----|--------|--------|--------|--------|--------|
| 0   | -79.69 | -78.28 | -76.88 | -75.48 | -74.07 |
| 10  | -72.67 | -71.26 | -69.86 | -68.45 | -67.05 |
| 20  | -65.64 | -64.24 | -62.83 | -61.43 | -60.02 |
| 30  | -58.62 | -57.21 | -55.81 | -54.40 | -53.00 |
| 40  | -51.59 | -50.19 | -48.78 | -47.38 | -45.97 |
| 50  | -44.57 | -43.17 | -41.76 | -40.36 | -38.95 |
| 60  | -37.55 | -36.14 | -34.74 | -33.33 | -31.93 |
| 70  | -30.52 | -29.12 | -27.71 | -26.31 | -24.90 |
| 80  | -23.50 | -22.09 | -20.69 | -19.28 | -17.88 |
| 90  | -16.47 | -15.07 | -13.66 | -12.26 | -10.85 |
| 100 | -9.45  | -8.05  | -6.64  | -5.24  | -3.83  |
| 110 | -2.43  | -1.02  | .38    | 1.79   | 3.19   |
| 120 | 4.60   | 6.00   | 7.41   | 8.81   | 10.22  |
| 130 | 11.62  | 13.03  | 14.43  | 15.84  | 17.24  |
| 140 | 18.65  | 20.05  | 21.46  | 22.86  | 24.26  |
| 150 | 25.67  | 27.07  | 28.48  | 29.88  | 31.29  |
| 160 | 32.69  | 34.10  | 35.50  | 36.91  | 38.31  |
| 170 | 39.72  | 41.12  | 42.53  | 43.93  | 45.34  |
| 180 | 46.74  | 48.15  | 49.55  | 50.96  | 52.36  |
| 190 | 53.77  | 55.17  | 56.57  | 57.98  | 59.38  |
| 200 | 60.79  | 62.19  | 63.60  | 65.00  | 66.41  |
| 210 | 67.81  | 69.22  | 70.62  | 72.03  | 73.43  |
| 220 | 74.84  | 76.24  | 77.65  | 79.05  | 80.46  |
| 230 | 81.86  | 83.27  | 84.67  | 86.08  | 87.48  |
| 240 | 88.89  | 90.29  | 91.69  | 93.10  | 94.50  |
| 250 | 95.91  | 97.31  | 98.72  | 100.12 |        |

DEG C

RUN 0747 0031CRS

MJS77 SERIAL NO..... MJS-3  
MJS77 FUNCTION ..... +10 V PWR SUPPLY VOLTAGE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 1

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 003

MEAS CALIB RANGE ... 0-12 VOLTS  
MEAS CALIB TEMP ..... -

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ... -  
XDUCER CALIB DATE .. 6/28/76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0747 0031CRS

STANDARD DEVIATION . .93591705-07

COEFFICIENT A0 ..... .30633891-01  
COEFFICIENT A1 ..... .41322887-01

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| .00             | -.74         | .0000         | -.000000 |
| 2.00            | 47.66        | 2.0000        | .000000  |
| 4.00            | 96.06        | 4.0000        | .000000  |
| 6.00            | 144.46       | 6.0000        | .000000  |
| 8.00            | 192.86       | 8.0000        | .000000  |
| 10.00           | 241.26       | 10.0000       | .000000  |
| 12.00           | 289.65       | 12.0000       | .000000  |

DATA NUMBER

|  | 0     | 2     | 4     | 6     | 8     | 9 |
|--|-------|-------|-------|-------|-------|---|
|  | .03   | .11   | .20   | .28   | .36   |   |
|  | .44   | .53   | .61   | .69   | .77   |   |
|  | .86   | .94   | 1.02  | 1.11  | 1.19  |   |
|  | 1.27  | 1.35  | 1.44  | 1.52  | 1.60  |   |
|  | 1.68  | 1.77  | 1.85  | 1.93  | 2.01  |   |
|  | 2.10  | 2.18  | 2.26  | 2.34  | 2.43  |   |
|  | 2.51  | 2.59  | 2.68  | 2.76  | 2.84  |   |
|  | 2.92  | 3.01  | 3.09  | 3.17  | 3.25  |   |
|  | 3.34  | 3.42  | 3.50  | 3.58  | 3.67  |   |
|  | 3.75  | 3.83  | 3.91  | 4.00  | 4.08  |   |
|  | 4.16  | 4.25  | 4.33  | 4.41  | 4.49  |   |
|  | 4.58  | 4.66  | 4.74  | 4.82  | 4.91  |   |
|  | 4.99  | 5.07  | 5.15  | 5.24  | 5.32  |   |
|  | 5.40  | 5.49  | 5.57  | 5.65  | 5.73  |   |
|  | 5.82  | 5.90  | 5.98  | 6.06  | 6.15  |   |
|  | 6.23  | 6.31  | 6.39  | 6.48  | 6.56  |   |
|  | 6.64  | 6.72  | 6.81  | 6.89  | 6.97  |   |
|  | 7.06  | 7.14  | 7.22  | 7.30  | 7.39  |   |
|  | 7.47  | 7.55  | 7.63  | 7.72  | 7.80  |   |
|  | 7.88  | 7.96  | 8.05  | 8.13  | 8.21  |   |
|  | 8.30  | 8.38  | 8.46  | 8.54  | 8.63  |   |
|  | 8.71  | 8.79  | 8.87  | 8.96  | 9.04  |   |
|  | 9.12  | 9.20  | 9.29  | 9.37  | 9.45  |   |
|  | 9.53  | 9.62  | 9.70  | 9.78  | 9.87  |   |
|  | 9.95  | 10.03 | 10.11 | 10.20 | 10.28 |   |
|  | 10.36 | 10.44 | 10.53 | 10.61 |       |   |

VOLTS

RUN 0737 0031CRS

MJS77 SERIAL NO..... MJS-3  
MJS77 FUNCTION ..... +6 V PWR SUPPLY VOLTAGE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 1

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 003

MEAS CALIB RANGE ... 0-8 VOLTSS  
MEAS CALIB TEMP .... -

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ... -  
XDUCER CALIB DATE .. 6/28/76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0737 0031CRS

STANDARD DEVIATION . .55217518-07

COEFFICIENT A0 ..... .18087302-01  
COEFFICIENT A1 ..... .24398545-01

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA   |
|-----------------|--------------|---------------|---------|
| .00             | -.74         | -.0000        | .000000 |
| 2.00            | 81.23        | 2.0000        | .000000 |
| 4.00            | 163.20       | 4.0000        | .000000 |
| 6.00            | 245.17       | 6.0000        | .000000 |
| 8.00            | 327.15       | 8.0000        | .000000 |

DATA NUMBER

|     | 0    | 2    | 4    | 6    | 8    | FRAME | 31 |
|-----|------|------|------|------|------|-------|----|
| 0   | .02  | .07  | .12  | .16  | .21  |       |    |
| 10  | .26  | .31  | .36  | .41  | .46  |       |    |
| 20  | .51  | .55  | .60  | .65  | .70  |       |    |
| 30  | .75  | .80  | .85  | .90  | .95  |       |    |
| 40  | .99  | 1.04 | 1.09 | 1.14 | 1.19 |       |    |
| 50  | 1.24 | 1.29 | 1.34 | 1.38 | 1.43 |       |    |
| 60  | 1.48 | 1.53 | 1.58 | 1.63 | 1.68 |       |    |
| 70  | 1.73 | 1.77 | 1.82 | 1.87 | 1.92 |       |    |
| 80  | 1.97 | 2.02 | 2.07 | 2.12 | 2.17 |       |    |
| 90  | 2.21 | 2.26 | 2.31 | 2.36 | 2.41 |       |    |
| 100 | 2.46 | 2.51 | 2.56 | 2.60 | 2.65 |       |    |
| 110 | 2.70 | 2.75 | 2.80 | 2.85 | 2.90 |       |    |
| 120 | 2.95 | 2.99 | 3.04 | 3.09 | 3.14 |       |    |
| 130 | 3.19 | 3.24 | 3.29 | 3.34 | 3.39 |       |    |
| 140 | 3.43 | 3.48 | 3.53 | 3.58 | 3.63 |       |    |
| 150 | 3.68 | 3.73 | 3.78 | 3.82 | 3.87 |       |    |
| 160 | 3.92 | 3.97 | 4.02 | 4.07 | 4.12 |       |    |
| 170 | 4.17 | 4.21 | 4.26 | 4.31 | 4.36 |       |    |
| 180 | 4.41 | 4.46 | 4.51 | 4.56 | 4.61 |       |    |
| 190 | 4.65 | 4.70 | 4.75 | 4.80 | 4.85 |       |    |
| 200 | 4.90 | 4.95 | 5.00 | 5.04 | 5.09 |       |    |
| 210 | 5.14 | 5.19 | 5.24 | 5.29 | 5.34 |       |    |
| 220 | 5.39 | 5.43 | 5.48 | 5.53 | 5.58 |       |    |
| 230 | 5.63 | 5.68 | 5.73 | 5.78 | 5.82 |       |    |
| 240 | 5.87 | 5.92 | 5.97 | 6.02 | 6.07 |       |    |
| 250 | 6.12 | 6.17 | 6.22 | 6.26 |      |       |    |

VOLTS

RUN 0737 0031CRS

MJS77 SERIAL NO..... MJS-3  
MJS77 FUNCTION ..... +3 V POWER SUPPLY VOLTAGE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 1

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 003

MEAS CALIB RANGE ... 0-4 VOLTS  
MEAS CALIB TEMP .... -

XDUCER SERIAL NO..... -  
XDUCER IMPEDANCE ... -  
XDUCER CALIB DATE .. 6/28/76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0737 0031CRS

STANDARD DEVIATION . .25423659-03

COEFFICIENT A0 ..... .88220622-02  
COEFFICIENT A1 ..... .12180280-01

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| .00             | -.74         | -.0002        | .000208  |
| 1.00            | 81.40        | 1.0003        | -.000311 |
| 2.00            | 163.46       | 1.9998        | .000208  |
| 3.00            | 245.60       | 3.0003        | -.000311 |
| 4.00            | 327.66       | 3.9998        | .000208  |

DATA NUMBER

|     | 0    | 2    | 4    | 6    | 8    |
|-----|------|------|------|------|------|
|     | .01  | .03  | .06  | .08  | .11  |
| 10  | .13  | .15  | .18  | .20  | .23  |
| 20  | .25  | .28  | .30  | .33  | .35  |
| 30  | .37  | .40  | .42  | .45  | .47  |
| 40  | .50  | .52  | .54  | .57  | .59  |
| 50  | .62  | .64  | .67  | .66  | .72  |
| 60  | .74  | .76  | .79  | .81  | .84  |
| 70  | .86  | .89  | .91  | .93  | .96  |
| 80  | .98  | 1.01 | 1.03 | 1.06 | 1.08 |
| 90  | 1.11 | 1.13 | 1.15 | 1.18 | 1.20 |
| 100 | 1.23 | 1.25 | 1.28 | 1.30 | 1.32 |
| 110 | 1.35 | 1.37 | 1.40 | 1.42 | 1.45 |
| 120 | 1.47 | 1.49 | 1.52 | 1.54 | 1.57 |
| 130 | 1.59 | 1.62 | 1.64 | 1.67 | 1.69 |
| 140 | 1.71 | 1.74 | 1.76 | 1.79 | 1.81 |
| 150 | 1.84 | 1.86 | 1.88 | 1.91 | 1.93 |
| 160 | 1.96 | 1.98 | 2.01 | 2.03 | 2.06 |
| 170 | 2.08 | 2.10 | 2.13 | 2.15 | 2.18 |
| 180 | 2.20 | 2.23 | 2.25 | 2.27 | 2.30 |
| 190 | 2.32 | 2.35 | 2.37 | 2.40 | 2.42 |
| 200 | 2.44 | 2.47 | 2.49 | 2.52 | 2.54 |
| 210 | 2.57 | 2.59 | 2.62 | 2.64 | 2.66 |
| 220 | 2.69 | 2.71 | 2.74 | 2.76 | 2.79 |
| 230 | 2.81 | 2.83 | 2.86 | 2.88 | 2.91 |
| 240 | 2.93 | 2.96 | 2.98 | 3.01 | 3.03 |
| 250 | 3.05 | 3.08 | 3.10 | 3.13 |      |

VOLTS

RUN 1757 0031CRS

MJS77 SERIAL NO..... MJS-3  
MJS77 FUNCTION ..... -3 V POWER SUPPLY VOLTAGE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 1

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 003

MEAS CALIB RANGE ... 0 TO -5 VOLTS  
MEAS CALIB TEMP .... -

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ... -  
XDUCER CALIB DATE .. 7-12-76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 1757 0031CRS

STANDARD DEVIATION . .33324333-07

COEFFICIENT A0 ..... -.38043421+01  
COEFFICIENT A1 ..... .15441711-01

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| .00             | 246.37       | -.0000        | .000000  |
| -1.00           | 181.61       | -1.0000       | -.000000 |
| -2.00           | 116.85       | -2.0000       | -.000000 |
| -3.00           | 52.09        | -3.0000       | -.000000 |
| -4.00           | -12.67       | -4.0000       | -.000000 |

DATA NUMBER

|     | 0     | 2     | 4     | 6     | 8     |
|-----|-------|-------|-------|-------|-------|
| 0   | -3.80 | -3.77 | -3.74 | -3.71 | -3.68 |
| 10  | -3.65 | -3.62 | -3.59 | -3.56 | -3.53 |
| 20  | -3.50 | -3.46 | -3.43 | -3.40 | -3.37 |
| 30  | -3.34 | -3.31 | -3.28 | -3.25 | -3.22 |
| 40  | -3.19 | -3.16 | -3.12 | -3.09 | -3.06 |
| 50  | -3.03 | -3.00 | -2.97 | -2.94 | -2.91 |
| 60  | -2.88 | -2.85 | -2.82 | -2.79 | -2.75 |
| 70  | -2.72 | -2.69 | -2.66 | -2.63 | -2.60 |
| 80  | -2.57 | -2.54 | -2.51 | -2.48 | -2.45 |
| 90  | -2.41 | -2.38 | -2.35 | -2.32 | -2.29 |
| 100 | -2.26 | -2.23 | -2.20 | -2.17 | -2.14 |
| 110 | -2.11 | -2.07 | -2.04 | -2.01 | -1.98 |
| 120 | -1.95 | -1.92 | -1.89 | -1.86 | -1.83 |
| 130 | -1.80 | -1.77 | -1.74 | -1.70 | -1.67 |
| 140 | -1.64 | -1.61 | -1.58 | -1.55 | -1.52 |
| 150 | -1.49 | -1.46 | -1.43 | -1.40 | -1.36 |
| 160 | -1.33 | -1.30 | -1.27 | -1.24 | -1.21 |
| 170 | -1.18 | -1.15 | -1.12 | -1.09 | -1.06 |
| 180 | -1.02 | -.99  | -.96  | -.93  | -.90  |
| 190 | -.87  | -.84  | -.81  | -.78  | -.75  |
| 200 | -.72  | -.69  | -.65  | -.62  | -.59  |
| 210 | -.56  | -.53  | -.50  | -.47  | -.44  |
| 220 | -.41  | -.38  | -.35  | -.31  | -.28  |
| 230 | -.25  | -.22  | -.19  | -.16  | -.13  |
| 240 | -.10  | -.07  | -.04  | -.01  | .03   |
| 250 | .06   | .09   | .12   | .15   |       |

VOLTS

E-367

CRS -3 V

Chg 2, 5 JUL 77

RUN 1757 0031CRS

MJS77 SERIAL NO..... MJS-3  
MJS77 FUNCTION ..... -6 V POWER SUPPLY VOLTAGE

FDS TREESWITCH ID ... 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 1

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 003

MEAS CALIB RANGE ... 0 TO -10 VOLTS  
MEAS CALIB TEMP .... -

DUCEP SERIAL NO.... -  
DUCEP IMPEDANCE ... -  
DUCEP CALIB DATE .. 7-12-76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 1757 0031CRS

STANDARD DEVIATION . .67015430-07

COEFFICIENT A0 ..... -.80313889+01  
COEFFICIENT A1 ..... .32599167-01

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| .00             | 246.37       | .0000         | -.000000 |
| -2.00           | 185.02       | -2.0000       | -.000000 |
| -4.00           | 123.67       | -4.0000       | -.000000 |
| -6.00           | 62.31        | -6.0000       | -.000000 |
| -8.00           | .96          | -8.0000       | -.000000 |

DATA NUMBER

|     | 0     | 2     | 4     | 6     | 8     |
|-----|-------|-------|-------|-------|-------|
| 0   | -8.03 | -7.97 | -7.90 | -7.84 | -7.77 |
| 10  | -7.71 | -7.64 | -7.58 | -7.51 | -7.44 |
| 20  | -7.38 | -7.31 | -7.25 | -7.18 | -7.12 |
| 30  | -7.05 | -6.99 | -6.92 | -6.86 | -6.79 |
| 40  | -6.73 | -6.66 | -6.60 | -6.53 | -6.47 |
| 50  | -6.40 | -6.34 | -6.27 | -6.21 | -6.14 |
| 60  | -6.08 | -6.01 | -5.95 | -5.88 | -5.81 |
| 70  | -5.75 | -5.68 | -5.62 | -5.55 | -5.49 |
| 80  | -5.42 | -5.36 | -5.29 | -5.23 | -5.16 |
| 90  | -5.10 | -5.03 | -4.97 | -4.90 | -4.84 |
| 100 | -4.77 | -4.71 | -4.64 | -4.58 | -4.51 |
| 110 | -4.45 | -4.38 | -4.32 | -4.25 | -4.18 |
| 120 | -4.12 | -4.05 | -3.99 | -3.92 | -3.86 |
| 130 | -3.79 | -3.73 | -3.66 | -3.60 | -3.53 |
| 140 | -3.47 | -3.40 | -3.34 | -3.27 | -3.21 |
| 150 | -3.14 | -3.08 | -3.01 | -2.95 | -2.88 |
| 160 | -2.82 | -2.75 | -2.69 | -2.62 | -2.55 |
| 170 | -2.49 | -2.42 | -2.36 | -2.29 | -2.23 |
| 180 | -2.16 | -2.10 | -2.03 | -1.97 | -1.90 |
| 190 | -1.84 | -1.77 | -1.71 | -1.64 | -1.58 |
| 200 | -1.51 | -1.45 | -1.38 | -1.32 | -1.25 |
| 210 | -1.19 | -1.12 | -1.06 | -.99  | -.92  |
| 220 | -.86  | -.79  | -.73  | -.66  | -.60  |
| 230 | -.53  | -.47  | -.40  | -.34  | -.27  |
| 240 | -.21  | -.14  | -.08  | -.01  | .05   |
| 250 | .12   | .18   | .25   | .31   |       |

VOLTS

E-368

CRS -6 V

Chg 2, 5 JUL 77

RUN 1757 0031CRS

|                      |                            |          |          | FRAME |        |        |        |        |        |
|----------------------|----------------------------|----------|----------|-------|--------|--------|--------|--------|--------|
|                      |                            |          |          | 0     | 2      | 4      | 6      | 7      |        |
|                      |                            |          |          |       |        |        | 8      |        |        |
| MJS77 SERIAL NO..... | MJS-3                      |          |          | 0     | -18.07 | -17.92 | -17.78 | -17.63 | -17.48 |
| MJS77 FUNCTION ..... | -12 V POWER SUPPLY VOLTAGE |          |          | 10    | -17.34 | -17.19 | -17.04 | -16.90 | -16.75 |
| FDS TREESWITCH ID .. | 29                         |          |          | 20    | -16.60 | -16.46 | -16.31 | -16.16 | -16.02 |
| FDS RANGE .....      | 0-3 VOLTS                  |          |          | 30    | -15.87 | -15.72 | -15.58 | -15.43 | -15.28 |
| FDS SERIAL NO.....   | 1                          |          |          | 40    | -15.14 | -14.99 | -14.84 | -14.70 | -14.55 |
| SUBASSY REF NO.....  | 2021                       |          |          | 50    | -14.40 | -14.26 | -14.11 | -13.96 | -13.82 |
| SUBASSY SERIAL NO... | 003                        |          |          | 60    | -13.67 | -13.52 | -13.38 | -13.23 | -13.08 |
| MEAS CALIB RANGE ... | 0 TO -14 VOLTS             |          |          | 70    | -12.94 | -12.79 | -12.64 | -12.50 | -12.35 |
| MEAS CALIB TEMP .... | -                          |          |          | 80    | -12.20 | -12.06 | -11.91 | -11.76 | -11.62 |
| XDUCFR SERIAL NO.... | -                          |          |          | 90    | -11.47 | -11.32 | -11.18 | -11.03 | -10.88 |
| XDUCER IMPEDANCE ... | -                          |          |          | 100   | -10.74 | -10.59 | -10.44 | -10.30 | -10.15 |
| XDUCER CALIB DATE .. | 7-12-76                    |          |          | 110   | -10.00 | -9.86  | -9.71  | -9.56  | -9.42  |
| DATA PREPARED BY ... | GSFC                       |          |          | 120   | -9.27  | -9.12  | -8.98  | -8.83  | -8.68  |
| APPROVED BY ...      | J. OTTE                    |          |          | 130   | -8.54  | -8.39  | -8.24  | -8.10  | -7.95  |
| APPROVED BY ...      | R. ROTTER                  |          |          | 140   | -7.80  | -7.66  | -7.51  | -7.36  | -7.22  |
| RUN DATE .....       | 1757 0031CRS               |          |          | 150   | -7.07  | -6.92  | -6.78  | -6.63  | -6.48  |
| STANDARD DEVIATION . | .19744284-06               |          |          | 160   | -6.33  | -6.19  | -6.04  | -5.89  | -5.75  |
| COEFFICIENT A0 ..... | -.18070625+02              |          |          | 170   | -5.60  | -5.45  | -5.31  | -5.16  | -5.01  |
| COEFFICIENT A1 ..... | .73348125-01               |          |          | 180   | -4.87  | -4.72  | -4.57  | -4.43  | -4.28  |
| MEASURAND            | OUTPUT                     | F(X)     | DELTA    | 190   | -4.13  | -3.99  | -3.84  | -3.69  | -3.55  |
| EU                   | DN                         | PRIME    |          | 200   | -3.40  | -3.25  | -3.11  | -2.96  | -2.81  |
| .00                  | 246.37                     | .0000    | -.000000 | 210   | -2.67  | -2.52  | -2.37  | -2.23  | -2.08  |
| -2.00                | 219.10                     | -2.0000  | -.000000 | 220   | -1.93  | -1.79  | -1.64  | -1.49  | -1.35  |
| -4.00                | 191.83                     | -4.0000  | -.000000 | 230   | -1.20  | -1.05  | -.91   | -.76   | -.61   |
| -6.00                | 164.57                     | -6.0000  | -.000000 | 240   | -.47   | -.32   | -.17   | -.03   | .12    |
| -8.00                | 137.30                     | -8.0000  | -.000000 | 250   | .27    | .41    | .56    | .71    |        |
| -10.00               | 110.03                     | -10.0000 | -.000000 |       |        |        |        |        |        |
| -12.00               | 82.76                      | -12.0000 | -.000000 |       |        |        |        |        |        |

DATA NUMBER

VOLTS

E-369

CRS -12 V

Chg 2, 5 JUL 77

RUN 0737 0031CRS

FRAME 39  
8

MJS77 SERIAL NO..... MJS-3  
MJS77 FUNCTION ..... LET A TEMPERATURE  
FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 1

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 003

MEAS CALIB RANGE ... 40 TO -50 DEG C  
MEAS CALIB TEMP .... -

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ... -  
XDUCER CALIB DATE .. 6/28/76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0737 0031CRS

STANDARD DEVIATION . .44052287+00

COEFFICIENT A0 ..... .67625049+02  
COEFFICIENT A1 ..... -.10565313+01  
COEFFICIENT A2 ..... .53530564-02  
COEFFICIENT A3 ..... -.12464208-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.30        | 39.4195       | .580481  |
| 30.00           | 43.74        | 30.6118       | -.611828 |
| 20.00           | 60.61        | 20.4783       | -.478339 |
| 10.00           | 82.93        | 9.7110        | .289041  |
| .00             | 110.37       | -.5346        | .534563  |
| -10.00          | 141.39       | -9.9747       | -.025335 |
| -20.00          | 173.09       | -19.5076      | -.492362 |
| -30.00          | 201.55       | -29.9138      | -.086205 |
| -40.00          | 224.04       | -40.5565      | .556489  |
| -50.00          | 239.72       | -49.7335      | -.266512 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      |
|-----|--------|--------|--------|--------|--------|
| 0   | 67.63  | 65.53  | 63.48  | 61.48  | 59.51  |
| 10  | 57.58  | 55.70  | 53.85  | 52.04  | 50.27  |
| 20  | 48.54  | 46.84  | 45.18  | 43.55  | 41.97  |
| 30  | 40.41  | 38.89  | 37.40  | 35.95  | 34.52  |
| 40  | 33.13  | 31.77  | 30.44  | 29.14  | 27.87  |
| 50  | 26.62  | 25.41  | 24.22  | 23.06  | 21.92  |
| 60  | 20.81  | 19.73  | 18.67  | 17.63  | 16.61  |
| 70  | 15.62  | 14.65  | 13.70  | 12.78  | 11.87  |
| 80  | 10.98  | 10.11  | 9.26   | 8.43   | 7.61   |
| 90  | 6.81   | 6.03   | 5.26   | 4.50   | 3.76   |
| 100 | 3.04   | 2.32   | 1.62   | .93    | .26    |
| 110 | -.41   | -1.07  | -1.72  | -2.36  | -2.99  |
| 120 | -3.61  | -4.23  | -4.84  | -5.45  | -6.06  |
| 130 | -6.64  | -7.23  | -7.82  | -8.41  | -8.99  |
| 140 | -9.57  | -10.15 | -10.73 | -11.31 | -11.89 |
| 150 | -12.48 | -13.06 | -13.65 | -14.24 | -14.84 |
| 160 | -15.44 | -16.04 | -16.65 | -17.27 | -17.89 |
| 170 | -18.52 | -19.16 | -19.80 | -20.46 | -21.13 |
| 180 | -21.80 | -22.49 | -23.19 | -23.90 | -24.63 |
| 190 | -25.36 | -26.11 | -26.88 | -27.66 | -28.46 |
| 200 | -29.27 | -30.10 | -30.95 | -31.82 | -32.70 |
| 210 | -33.61 | -34.53 | -35.48 | -36.44 | -37.43 |
| 220 | -38.44 | -39.48 | -40.53 | -41.61 | -42.72 |
| 230 | -43.85 | -45.01 | -46.19 | -47.41 | -48.64 |
| 240 | -49.91 | -51.21 | -52.53 | -53.89 | -55.28 |
| 250 | -56.70 | -58.15 | -59.63 | -61.14 |        |

DEG C

RUN 0737 0031CRS

MJS77 SERIAL NO..... MJS-3  
MJS77 FUNCTION ..... LET B TEMPERATURE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 1

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 003

MEAS CALIB RANGE ... 40 TO -50 DEG C  
MEAS CALIB TEMP .... -

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ... -  
XDUCER CALIB DATE .. 6/28/76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0737 0031CRS

STANDARD DEVIATION . .44052287+00

COEFFICIENT A0 ..... .67625049+02  
COEFFICIENT A1 ..... -.10565313+01  
COEFFICIENT A2 ..... .53530554-02  
COEFFICIENT A3 ..... -.12464208-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.30        | 39.4195       | .580481  |
| 30.00           | 43.74        | 30.6118       | -.611828 |
| 20.00           | 60.61        | 20.4783       | -.478339 |
| 10.00           | 82.93        | 9.7110        | .289041  |
| .00             | 110.37       | -.5346        | .534563  |
| -10.00          | 141.39       | -9.9747       | -.025335 |
| -20.00          | 173.09       | -19.5076      | -.492362 |
| -30.00          | 201.55       | -29.9138      | -.086205 |
| -40.00          | 224.04       | -40.5565      | .556489  |
| -50.00          | 239.72       | -49.7335      | -.266512 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      | FRAME 43 |
|-----|--------|--------|--------|--------|--------|----------|
| 0   | 67.63  | 65.53  | 63.48  | 61.48  | 59.51  |          |
| 10  | 57.58  | 55.70  | 53.85  | 52.04  | 50.27  |          |
| 20  | 48.54  | 46.84  | 45.18  | 43.55  | 41.97  |          |
| 30  | 40.41  | 38.89  | 37.40  | 35.95  | 34.52  |          |
| 40  | 33.13  | 31.77  | 30.44  | 29.14  | 27.87  |          |
| 50  | 26.62  | 25.41  | 24.22  | 23.06  | 21.92  |          |
| 60  | 20.81  | 19.73  | 18.67  | 17.63  | 16.61  |          |
| 70  | 15.62  | 14.65  | 13.70  | 12.78  | 11.87  |          |
| 80  | 10.98  | 10.11  | 9.26   | 8.43   | 7.61   |          |
| 90  | 6.81   | 6.03   | 5.26   | 4.50   | 3.76   |          |
| 100 | 3.04   | 2.32   | 1.62   | .93    | .26    |          |
| 110 | -.41   | -1.07  | -1.72  | -2.36  | -2.99  |          |
| 120 | -3.61  | -4.23  | -4.84  | -5.45  | -6.05  |          |
| 130 | -6.64  | -7.23  | -7.82  | -8.41  | -8.99  |          |
| 140 | -9.57  | -10.15 | -10.73 | -11.31 | -11.89 |          |
| 150 | -12.48 | -13.06 | -13.65 | -14.24 | -14.84 |          |
| 160 | -15.44 | -16.04 | -16.65 | -17.27 | -17.89 |          |
| 170 | -18.52 | -19.16 | -19.80 | -20.46 | -21.13 |          |
| 180 | -21.80 | -22.49 | -23.19 | -23.90 | -24.63 |          |
| 190 | -25.36 | -26.11 | -26.88 | -27.66 | -28.46 |          |
| 200 | -29.27 | -30.10 | -30.95 | -31.82 | -32.70 |          |
| 210 | -33.61 | -34.53 | -35.48 | -36.44 | -37.43 |          |
| 220 | -38.44 | -39.48 | -40.53 | -41.61 | -42.72 |          |
| 230 | -43.85 | -45.01 | -46.19 | -47.41 | -48.64 |          |
| 240 | -49.91 | -51.21 | -52.53 | -53.89 | -55.28 |          |
| 250 | -56.70 | -58.15 | -59.63 | -61.14 |        |          |

DEG C

RUN 0737 0031CRS

MJS77 SERIAL NO..... MJS-3  
MJS77 FUNCTION ..... LET C TEMPERATURE  
FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 1  
SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 003  
MEAS CALIB RANGE ... 40 TO -50 DEG C  
MEAS CALIB TEMP .... -  
XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ... -  
XDUCER CALIB DATE .. 6/28/76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0737 0031CRS

STANDARD DEVIATION . .44052287+00

COEFFICIENT A0 ..... .67625049+02  
COEFFICIENT A1 ..... -.10565313+01  
COEFFICIENT A2 ..... .53530554-02  
COEFFICIENT A3 ..... -.12464208-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.30        | 39.4195       | .580481  |
| 30.00           | 43.74        | 30.6118       | -.611828 |
| 20.00           | 60.61        | 20.4783       | -.478339 |
| 10.00           | 82.93        | 9.7110        | .289041  |
| .00             | 110.37       | -.5346        | .534563  |
| -10.00          | 141.39       | -9.9747       | -.025335 |
| -20.00          | 173.09       | -19.5076      | -.492362 |
| -30.00          | 201.55       | -29.9138      | -.086205 |
| -40.00          | 224.04       | -40.5565      | .556489  |
| -50.00          | 239.72       | -49.7335      | -.266512 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      |
|-----|--------|--------|--------|--------|--------|
| 0   | 67.63  | 65.53  | 63.48  | 61.48  | 59.51  |
| 10  | 57.58  | 55.70  | 53.85  | 52.04  | 50.27  |
| 20  | 48.54  | 46.84  | 45.18  | 43.55  | 41.97  |
| 30  | 40.41  | 38.89  | 37.40  | 35.95  | 34.52  |
| 40  | 33.13  | 31.77  | 30.44  | 29.14  | 27.87  |
| 50  | 26.62  | 25.41  | 24.22  | 23.06  | 21.92  |
| 60  | 20.81  | 19.73  | 18.67  | 17.63  | 16.61  |
| 70  | 15.62  | 14.65  | 13.70  | 12.78  | 11.87  |
| 80  | 10.98  | 10.11  | 9.26   | 8.43   | 7.61   |
| 90  | 6.81   | 6.03   | 5.26   | 4.50   | 3.76   |
| 100 | 3.04   | 2.32   | 1.62   | .93    | .26    |
| 110 | -.41   | -1.07  | -1.72  | -2.36  | -2.99  |
| 120 | -3.61  | -4.23  | -4.84  | -5.45  | -6.05  |
| 130 | -6.64  | -7.23  | -7.82  | -8.41  | -8.99  |
| 140 | -9.57  | -10.15 | -10.73 | -11.31 | -11.89 |
| 150 | -12.48 | -13.06 | -13.65 | -14.24 | -14.84 |
| 160 | -15.44 | -16.04 | -16.65 | -17.27 | -17.89 |
| 170 | -18.52 | -19.16 | -19.80 | -20.46 | -21.13 |
| 180 | -21.80 | -22.49 | -23.19 | -23.90 | -24.63 |
| 190 | -25.36 | -26.11 | -26.88 | -27.66 | -28.46 |
| 200 | -29.27 | -30.10 | -30.95 | -31.82 | -32.70 |
| 210 | -33.61 | -34.53 | -35.48 | -36.44 | -37.43 |
| 220 | -38.44 | -39.48 | -40.53 | -41.61 | -42.72 |
| 230 | -43.85 | -45.01 | -46.19 | -47.41 | -48.64 |
| 240 | -49.91 | -51.21 | -52.53 | -53.89 | -55.28 |
| 250 | -56.70 | -58.15 | -59.63 | -61.14 |        |

DEG C

RUN 0737 0031CRS

MJS77 SERIAL NO..... MJS-3  
MJS77 FUNCTION ..... LET D TEMPERATURE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 1

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 003

MEAS CALIB RANGE ... 40 TO -50 DEG C  
MEAS CALIB TEMP .... -

XDUCCER SERIAL NO.... -  
XDUCCER IMPEDANCE ... -  
XDUCCER CALIB DATE .. 6/28/76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0737 0031CRS

STANDARD DEVIATION . .44052287+00

COEFFICIENT A0 ..... .67625049+02  
COEFFICIENT A1 ..... -.10565313+01  
COEFFICIENT A2 ..... .53530554-02  
COEFFICIENT A3 ..... -.12464208-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.30        | 39.4195       | .580481  |
| 30.00           | 43.74        | 30.6118       | -.611828 |
| 20.00           | 60.61        | 20.4783       | -.478339 |
| 10.00           | 82.93        | 9.7110        | .289041  |
| .00             | 110.37       | -.5346        | .534563  |
| -10.00          | 141.39       | -9.9747       | -.025335 |
| -20.00          | 173.09       | -19.5076      | -.492362 |
| -30.00          | 201.55       | -29.9138      | -.086205 |
| -40.00          | 224.04       | -40.5565      | .556489  |
| -50.00          | 239.72       | -49.7335      | -.266512 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      |
|-----|--------|--------|--------|--------|--------|
| 0   | 67.63  | 65.53  | 63.48  | 61.48  | 59.51  |
| 10  | 57.58  | 55.70  | 53.85  | 52.04  | 50.27  |
| 20  | 48.54  | 46.84  | 45.18  | 43.55  | 41.97  |
| 30  | 40.41  | 38.89  | 37.40  | 35.95  | 34.52  |
| 40  | 33.13  | 31.77  | 30.44  | 29.14  | 27.87  |
| 50  | 26.62  | 25.41  | 24.22  | 23.06  | 21.92  |
| 60  | 20.81  | 19.73  | 18.67  | 17.63  | 16.61  |
| 70  | 15.62  | 14.65  | 13.70  | 12.78  | 11.87  |
| 80  | 10.98  | 10.11  | 9.26   | 8.43   | 7.61   |
| 90  | 6.81   | 6.03   | 5.26   | 4.50   | 3.76   |
| 100 | 3.04   | 2.32   | 1.62   | .93    | .26    |
| 110 | -.41   | -1.07  | -1.72  | -2.36  | -2.99  |
| 120 | -3.61  | -4.23  | -4.84  | -5.45  | -6.05  |
| 130 | -6.64  | -7.23  | -7.82  | -8.41  | -8.99  |
| 140 | -9.57  | -10.15 | -10.73 | -11.31 | -11.89 |
| 150 | -12.48 | -13.06 | -13.65 | -14.24 | -14.84 |
| 160 | -15.44 | -16.04 | -16.65 | -17.27 | -17.89 |
| 170 | -18.52 | -19.16 | -19.80 | -20.46 | -21.13 |
| 180 | -21.80 | -22.49 | -23.19 | -23.90 | -24.63 |
| 190 | -25.36 | -26.11 | -26.88 | -27.66 | -28.46 |
| 200 | -29.27 | -30.10 | -30.95 | -31.82 | -32.70 |
| 210 | -33.61 | -34.53 | -35.48 | -36.44 | -37.43 |
| 220 | -38.44 | -39.48 | -40.53 | -41.61 | -42.72 |
| 230 | -43.85 | -45.01 | -46.19 | -47.41 | -48.64 |
| 240 | -49.91 | -51.21 | -52.53 | -53.89 | -55.28 |
| 250 | -56.70 | -58.15 | -59.63 | -61.14 |        |

DEG C

RUN 0737 0031CRS

FRAME 55

MJS77 SERIAL NO..... MJS-3  
MJS77 FUNCTION ..... HET A TEMPERATURE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 1

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO.... 003

MEAS CALIB RANGE ... 40 TO -50 DEG C  
MEAS CALIB TEMP .... -

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ... -  
XDUCER CALIB DATE .. 6/28/76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0737 0031CRS

STANDARD DEVIATION . .44052287\*00

COEFFICIENT A0 ..... .67625049+02  
COEFFICIENT A1 ..... -.10565313+01  
COEFFICIENT A2 ..... .53530554-02  
COEFFICIENT A3 ..... -.12464208-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.30        | 39.4195       | .580481  |
| 30.00           | 43.74        | 30.6118       | -.611828 |
| 20.00           | 60.61        | 20.4783       | -.478339 |
| 10.00           | 82.93        | 9.7110        | .289041  |
| .00             | 110.37       | -.5346        | .534563  |
| -10.00          | 141.39       | -9.9747       | -.025335 |
| -20.00          | 173.09       | -19.5076      | -.492362 |
| -30.00          | 201.55       | -29.9138      | -.086205 |
| -40.00          | 224.04       | -40.5565      | .556489  |
| -50.00          | 239.72       | -49.7335      | -.266512 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      |
|-----|--------|--------|--------|--------|--------|
| 0   | 67.63  | 65.53  | 63.48  | 61.48  | 59.51  |
| 10  | 57.58  | 55.70  | 53.85  | 52.04  | 50.27  |
| 20  | 48.54  | 46.84  | 45.18  | 43.55  | 41.97  |
| 30  | 40.41  | 38.89  | 37.40  | 35.95  | 34.52  |
| 40  | 33.13  | 31.77  | 30.44  | 29.14  | 27.87  |
| 50  | 26.62  | 25.41  | 24.22  | 23.06  | 21.92  |
| 60  | 20.81  | 19.73  | 18.67  | 17.63  | 16.61  |
| 70  | 15.62  | 14.65  | 13.70  | 12.78  | 11.87  |
| 80  | 10.98  | 10.11  | 9.26   | 8.43   | 7.61   |
| 90  | 6.81   | 6.03   | 5.26   | 4.50   | 3.76   |
| 100 | 3.04   | 2.32   | 1.62   | .93    | .26    |
| 110 | -.41   | -1.07  | -1.72  | -2.36  | -2.99  |
| 120 | -3.61  | -4.23  | -4.84  | -5.45  | -6.05  |
| 130 | -6.64  | -7.23  | -7.82  | -8.41  | -8.99  |
| 140 | -9.57  | -10.15 | -10.73 | -11.31 | -11.89 |
| 150 | -12.48 | -13.06 | -13.65 | -14.24 | -14.84 |
| 160 | -15.44 | -16.04 | -16.65 | -17.27 | -17.89 |
| 170 | -18.52 | -19.16 | -19.80 | -20.46 | -21.13 |
| 180 | -21.80 | -22.49 | -23.19 | -23.90 | -24.63 |
| 190 | -25.36 | -26.11 | -26.88 | -27.66 | -28.46 |
| 200 | -29.27 | -30.10 | -30.95 | -31.82 | -32.70 |
| 210 | -33.61 | -34.53 | -35.48 | -36.44 | -37.43 |
| 220 | -38.44 | -39.48 | -40.53 | -41.61 | -42.72 |
| 230 | -43.85 | -45.01 | -46.19 | -47.41 | -48.64 |
| 240 | -49.91 | -51.21 | -52.53 | -53.89 | -55.28 |
| 250 | -56.70 | -58.15 | -59.63 | -61.14 |        |

DEG C

RUN 0737 0031CRS

FRAME 59  
8

MJS77 SERIAL NO..... MJS-3  
MJS77 FUNCTION ..... HET B TEMPERATURE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 1

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 003

MEAS CALIB RANGE ... 40 TO -50 DEG C  
MEAS CALIB TEMP .... -

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ... -  
XDUCER CALIB DATE .. 6/28/76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0737 0031CRS

STANDARD DEVIATION . .44052287+00

COEFFICIENT A0 ..... .67625049+02  
COEFFICIENT A1 ..... -.10565313+01  
COEFFICIENT A2 ..... .53530554-02  
COEFFICIENT A3 ..... -.12464208-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.30        | 39.4195       | .580481  |
| 30.00           | 43.74        | 30.6118       | -.611828 |
| 20.00           | 60.61        | 20.4783       | -.478339 |
| 10.00           | 82.93        | 9.7110        | .289041  |
| .00             | 110.37       | -.5346        | .534563  |
| -10.00          | 141.39       | -9.9747       | -.025335 |
| -20.00          | 173.09       | -19.5076      | -.492362 |
| -30.00          | 201.55       | -29.9138      | -.086205 |
| -40.00          | 224.04       | -40.5565      | .556489  |
| -50.00          | 239.72       | -49.7335      | -.266512 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      |
|-----|--------|--------|--------|--------|--------|
| 0   | 67.63  | 65.53  | 63.48  | 61.48  | 59.51  |
| 10  | 57.58  | 55.70  | 53.85  | 52.04  | 50.27  |
| 20  | 48.54  | 46.84  | 45.18  | 43.55  | 41.97  |
| 30  | 40.41  | 38.89  | 37.40  | 35.95  | 34.52  |
| 40  | 33.13  | 31.77  | 30.44  | 29.14  | 27.87  |
| 50  | 26.62  | 25.41  | 24.22  | 23.06  | 21.92  |
| 60  | 20.81  | 19.73  | 18.67  | 17.63  | 16.61  |
| 70  | 15.62  | 14.65  | 13.70  | 12.78  | 11.87  |
| 80  | 10.98  | 10.11  | 9.26   | 8.43   | 7.61   |
| 90  | 6.81   | 6.03   | 5.26   | 4.50   | 3.76   |
| 100 | 3.04   | 2.32   | 1.62   | .93    | .26    |
| 110 | -.41   | -1.07  | -1.72  | -2.36  | -2.99  |
| 120 | -3.61  | -4.23  | -4.84  | -5.45  | -6.05  |
| 130 | -6.64  | -7.23  | -7.82  | -8.41  | -8.99  |
| 140 | -9.57  | -10.15 | -10.73 | -11.31 | -11.89 |
| 150 | -12.48 | -13.06 | -13.65 | -14.24 | -14.84 |
| 160 | -15.44 | -16.04 | -16.65 | -17.27 | -17.89 |
| 170 | -18.52 | -19.16 | -19.80 | -20.46 | -21.13 |
| 180 | -21.80 | -22.49 | -23.19 | -23.90 | -24.63 |
| 190 | -25.36 | -26.11 | -26.88 | -27.66 | -28.46 |
| 200 | -29.27 | -30.10 | -30.95 | -31.82 | -32.70 |
| 210 | -33.61 | -34.53 | -35.48 | -36.44 | -37.43 |
| 220 | -38.44 | -39.48 | -40.53 | -41.61 | -42.72 |
| 230 | -43.85 | -45.01 | -46.19 | -47.41 | -48.64 |
| 240 | -49.91 | -51.21 | -52.53 | -53.89 | -55.28 |
| 250 | -56.70 | -58.15 | -59.63 | -61.14 |        |

DEG C

RUN 0737 0031CRS

FRAME 63

MJS77 SERIAL NO..... MJS-3  
MJS77 FUNCTION ..... TET TEMPERATURE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 1

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 003

MEAS CALIB RANGE ... 40 TO -50 DEG C  
MEAS CALIB TEMP .... -

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ... -  
XDUCER CALIB DATE .. 6/28/76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0737 0031CRS

STANDARD DEVIATION . .44052287+00

COEFFICIENT A0 ..... :67625049+02  
COEFFICIENT A1 ..... -.10565313+01  
COEFFICIENT A2 ..... :53530554-02  
COEFFICIENT A3 ..... -.12464208-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.30        | 39.4195       | .580481  |
| 30.00           | 43.74        | 30.6118       | -.611828 |
| 20.00           | 60.61        | 20.4783       | -.478339 |
| 10.00           | 82.93        | 9.7110        | .289041  |
| .00             | 110.37       | -.5346        | .534563  |
| -10.00          | 141.39       | -9.9747       | -.025335 |
| -20.00          | 173.09       | -19.5076      | -.492362 |
| -30.00          | 201.55       | -29.9138      | -.086205 |
| -40.00          | 224.04       | -40.5565      | .556489  |
| -50.00          | 239.72       | -49.7335      | -.266512 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      |
|-----|--------|--------|--------|--------|--------|
| 0   | 67.63  | 65.53  | 63.48  | 61.48  | 59.51  |
| 10  | 57.58  | 55.70  | 53.85  | 52.04  | 50.27  |
| 20  | 48.54  | 46.84  | 45.18  | 43.55  | 41.97  |
| 30  | 40.41  | 38.89  | 37.40  | 35.95  | 34.52  |
| 40  | 33.13  | 31.77  | 30.44  | 29.14  | 27.87  |
| 50  | 26.62  | 25.41  | 24.22  | 23.06  | 21.92  |
| 60  | 20.81  | 19.73  | 18.67  | 17.63  | 16.61  |
| 70  | 15.62  | 14.65  | 13.70  | 12.78  | 11.87  |
| 80  | 10.98  | 10.11  | 9.26   | 8.43   | 7.61   |
| 90  | 6.81   | 6.03   | 5.26   | 4.50   | 3.76   |
| 100 | 3.04   | 2.32   | 1.62   | .93    | .26    |
| 110 | -.41   | -1.07  | -1.72  | -2.36  | -2.99  |
| 120 | -3.61  | -4.23  | -4.84  | -5.45  | -6.05  |
| 130 | -6.64  | -7.23  | -7.82  | -8.41  | -8.99  |
| 140 | -9.57  | -10.15 | -10.73 | -11.31 | -11.89 |
| 150 | -12.48 | -13.06 | -13.65 | -14.24 | -14.84 |
| 160 | -15.44 | -16.04 | -16.65 | -17.27 | -17.89 |
| 170 | -18.52 | -19.16 | -19.80 | -20.46 | -21.13 |
| 180 | -21.80 | -22.49 | -23.19 | -23.90 | -24.63 |
| 190 | -25.36 | -26.11 | -26.88 | -27.66 | -28.46 |
| 200 | -29.27 | -30.10 | -30.95 | -31.82 | -32.70 |
| 210 | -33.61 | -34.53 | -35.48 | -36.44 | -37.43 |
| 220 | -38.44 | -39.48 | -40.53 | -41.61 | -42.72 |
| 230 | -43.85 | -45.01 | -46.19 | -47.41 | -48.64 |
| 240 | -49.91 | -51.21 | -52.53 | -53.89 | -55.28 |
| 250 | -56.70 | -58.15 | -59.63 | -61.14 |        |

DEG C

RUN 0737 0031CRS

|  | 0      | 2        | 4        | 6      | 8      |        |
|--|--------|----------|----------|--------|--------|--------|
| MJS77 SERIAL NO..... MJS-3                       | 0      | 67.63    | 65.53    | 63.48  | 61.48  | 59.51  |
| MJS77 FUNCTION ..... POWER CONVERTER TEMPERATURE | 10     | 57.58    | 55.70    | 53.85  | 52.04  | 50.27  |
| FDS TREESWITCH ID .. 29                          | 20     | 48.54    | 46.84    | 45.18  | 43.55  | 41.97  |
| FDS RANGE ..... 0-3 VOLTS                        | 30     | 40.41    | 38.89    | 37.40  | 35.95  | 34.52  |
| FDS SERIAL NO..... 1                             | 40     | 33.13    | 31.77    | 30.44  | 29.14  | 27.87  |
| SUBASSY REF NO..... 2021                         | 50     | 26.62    | 25.41    | 24.22  | 23.06  | 21.92  |
| SUBASSY SERIAL NO... 003                         | 60     | 20.81    | 19.73    | 18.67  | 17.63  | 16.61  |
| MEAS CALIB RANGE ... 40 TO -50 DEG C             | 70     | 15.62    | 14.65    | 13.70  | 12.78  | 11.87  |
| MEAS CALIB TEMP .... -                           | 80     | 10.98    | 10.11    | 9.26   | 8.43   | 7.61   |
| XDUCER SERIAL NO.... -                           | 90     | 6.81     | 6.03     | 5.26   | 4.50   | 3.76   |
| XDUCER IMPEDANCE ... -                           | 100    | 3.04     | 2.32     | 1.62   | .93    | .26    |
| XDUCER CALIB DATE .. 6/28/76                     | 110    | -.41     | -1.07    | -1.72  | -2.36  | -2.99  |
| DATA PREPARED BY ... GSFC                        | 120    | -3.61    | -4.23    | -4.84  | -5.45  | -6.05  |
| APPROVED BY ... J. OTTE                          | 130    | -6.64    | -7.23    | -7.82  | -8.41  | -8.99  |
| APPROVED BY ... R. ROTTER                        | 140    | -9.57    | -10.15   | -10.73 | -11.31 | -11.89 |
| RUN DATE ..... 0737 0031CRS                      | 150    | -12.48   | -13.06   | -13.65 | -14.24 | -14.84 |
| STANDARD DEVIATION . .44052287+00                | 160    | -15.44   | -16.04   | -16.65 | -17.27 | -17.89 |
| COEFFICIENT A0 ..... .67625049+02                | 170    | -18.52   | -19.16   | -19.80 | -20.46 | -21.13 |
| COEFFICIENT A1 ..... -.10565313+01               | 180    | -21.80   | -22.49   | -23.19 | -23.90 | -24.63 |
| COEFFICIENT A2 ..... .53530554-02                | 190    | -25.36   | -26.11   | -26.88 | -27.66 | -28.46 |
| COEFFICIENT A3 ..... -.12464208-04               | 200    | -29.27   | -30.10   | -30.95 | -31.82 | -32.70 |
| MEASURAND  | 210    | -33.61   | -34.53   | -35.48 | -36.44 | -37.43 |
| EU   | 220    | -38.44   | -39.48   | -40.53 | -41.61 | -42.72 |
| OUTPUT   | 230    | -43.85   | -45.01   | -46.19 | -47.41 | -48.64 |
| DN   | 240    | -49.91   | -51.21   | -52.53 | -53.89 | -55.28 |
| F(X)   | 250    | -56.70   | -58.15   | -59.63 | -61.14 |        |
| PRIME  |        |          |          |        |        |        |
| DELTA  |        |          |          |        |        |        |
| 40.00  | 31.30  | 39.4195  | .580481  |        |        |        |
| 30.00  | 43.74  | 30.6118  | -.611828 |        |        |        |
| 20.00  | 60.61  | 20.4783  | -.478339 |        |        |        |
| 10.00  | 82.93  | 9.7110   | .289041  |        |        |        |
| .00  | 110.37 | -.5346   | .534563  |        |        |        |
| -10.00   | 141.39 | -9.9747  | -.025335 |        |        |        |
| -20.00   | 173.09 | -19.5076 | -.492362 |        |        |        |
| -30.00   | 201.55 | -29.9138 | -.086205 |        |        |        |
| -40.00   | 224.04 | -40.5565 | .556489  |        |        |        |
| -50.00   | 239.72 | -49.7335 | -.266512 |        |        |        |

DATA NUMBER

DEG C

RUN 0737 0031CRS

MJS77 SERIAL NO..... MJS-3  
MJS77 FUNCTION ..... BASEPLATE TEMPERATURE

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 1

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 003

MEAS CALIB RANGE ... 40 TO -50 DEG C  
MEAS CALIB TEMP .... -

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ... -  
XDUCER CALIB DATE .. 6/28/76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 0737 0031CRS

STANDARD DEVIATION . .44052287+00

COEFFICIENT A0 ..... .67625049+02  
COEFFICIENT A1 ..... -.10565313+01  
COEFFICIENT A2 ..... .53530554-02  
COEFFICIENT A3 ..... -.12464208-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.30        | 39.4195       | .580481  |
| 30.00           | 43.74        | 30.6118       | -.611828 |
| 20.00           | 60.61        | 20.4783       | -.478339 |
| 10.00           | 82.93        | 9.7110        | .289041  |
| .00             | 110.37       | -.5346        | .534563  |
| -10.00          | 141.39       | -9.9747       | -.025335 |
| -20.00          | 173.09       | -19.5076      | -.492362 |
| -30.00          | 201.55       | -29.9138      | -.086205 |
| -40.00          | 224.04       | -40.5565      | .556489  |
| -50.00          | 239.72       | -49.7335      | -.266512 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      | FRAME 71 |
|-----|--------|--------|--------|--------|--------|----------|
| 0   | 67.63  | 65.53  | 63.48  | 61.48  | 59.51  |          |
| 10  | 57.58  | 55.70  | 53.85  | 52.04  | 50.27  |          |
| 20  | 48.54  | 46.84  | 45.18  | 43.55  | 41.97  |          |
| 30  | 40.41  | 38.89  | 37.40  | 35.95  | 34.52  |          |
| 40  | 33.13  | 31.77  | 30.44  | 29.14  | 27.87  |          |
| 50  | 26.62  | 25.41  | 24.22  | 23.06  | 21.92  |          |
| 60  | 20.81  | 19.73  | 18.67  | 17.63  | 16.61  |          |
| 70  | 15.62  | 14.65  | 13.70  | 12.78  | 11.87  |          |
| 80  | 10.98  | 10.11  | 9.26   | 8.43   | 7.61   |          |
| 90  | 6.81   | 6.03   | 5.26   | 4.50   | 3.76   |          |
| 100 | 3.04   | 2.32   | 1.62   | .93    | .26    |          |
| 110 | -.41   | -1.07  | -1.72  | -2.36  | -2.99  |          |
| 120 | -3.61  | -4.23  | -4.84  | -5.45  | -6.05  |          |
| 130 | -6.64  | -7.23  | -7.82  | -8.41  | -8.99  |          |
| 140 | -9.57  | -10.15 | -10.73 | -11.31 | -11.89 |          |
| 150 | -12.48 | -13.06 | -13.65 | -14.24 | -14.84 |          |
| 160 | -15.44 | -16.04 | -16.65 | -17.27 | -17.89 |          |
| 170 | -18.52 | -19.16 | -19.80 | -20.46 | -21.13 |          |
| 180 | -21.80 | -22.49 | -23.19 | -23.90 | -24.63 |          |
| 190 | -25.36 | -26.11 | -26.88 | -27.66 | -28.46 |          |
| 200 | -29.27 | -30.10 | -30.95 | -31.82 | -32.70 |          |
| 210 | -33.61 | -34.53 | -35.48 | -36.44 | -37.43 |          |
| 220 | -38.44 | -39.48 | -40.53 | -41.61 | -42.72 |          |
| 230 | -43.85 | -45.01 | -46.19 | -47.41 | -48.64 |          |
| 240 | -49.91 | -51.21 | -52.53 | -53.89 | -55.28 |          |
| 250 | -56.70 | -58.15 | -59.63 | -61.14 |        |          |

DEG C

RUN 1757 0031CRS

MJS77 SERIAL NO. .... MJS-3  
MJS77 FUNCTION ..... PHA ELECTRONICS TEMPERATURE

FDS TPEESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 1

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 003

MEAS CALIB RANGE ... 60 TO -60 DEG C  
MEAS CALIB TEMP .... -

XDUCEP SERIAL NO.... -  
XDUCEP IMPEDANCE ... -  
XDUCEP CALIB DATE .. 6-28-76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 1757 0031CRS

STANDARD DEVIATION . .44052287+00

COEFFICIENT A0 ..... .67625049+02  
COEFFICIENT A1 ..... -.10565313+01  
COEFFICIENT A2 ..... .53530554-02  
COEFFICIENT A3 ..... -.12464208-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.30        | 39.4195       | .580481  |
| 30.00           | 43.74        | 30.6118       | -.611828 |
| 20.00           | 60.61        | 20.4783       | -.478339 |
| 10.00           | 82.93        | 9.7110        | .289041  |
| .00             | 110.37       | -.5346        | .534563  |
| -10.00          | 141.39       | -9.9747       | -.025335 |
| -20.00          | 173.09       | -19.5076      | -.492362 |
| -30.00          | 201.55       | -29.9138      | -.086205 |
| -40.00          | 224.04       | -40.5565      | .556489  |
| -50.00          | 239.72       | -49.7335      | -.266512 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      | FRAME 11 |
|-----|--------|--------|--------|--------|--------|----------|
| 0   | 67.63  | 65.53  | 63.48  | 61.48  | 59.51  |          |
| 10  | 57.58  | 55.70  | 53.85  | 52.04  | 50.27  |          |
| 20  | 48.54  | 46.84  | 45.18  | 43.55  | 41.97  |          |
| 30  | 40.41  | 38.89  | 37.40  | 35.95  | 34.52  |          |
| 40  | 33.13  | 31.77  | 30.44  | 29.14  | 27.87  |          |
| 50  | 26.62  | 25.41  | 24.22  | 23.06  | 21.92  |          |
| 60  | 20.81  | 19.73  | 18.67  | 17.63  | 16.61  |          |
| 70  | 15.62  | 14.65  | 13.70  | 12.78  | 11.87  |          |
| 80  | 10.98  | 10.11  | 9.26   | 8.43   | 7.61   |          |
| 90  | 6.81   | 6.03   | 5.26   | 4.50   | 3.76   |          |
| 100 | 3.04   | 2.32   | 1.62   | .93    | .26    |          |
| 110 | -.41   | -1.07  | -1.72  | -2.36  | -2.99  |          |
| 120 | -3.61  | -4.23  | -4.84  | -5.45  | -6.05  |          |
| 130 | -6.64  | -7.23  | -7.82  | -8.41  | -8.99  |          |
| 140 | -9.57  | -10.15 | -10.73 | -11.31 | -11.89 |          |
| 150 | -12.48 | -13.06 | -13.65 | -14.24 | -14.84 |          |
| 160 | -15.44 | -16.04 | -16.65 | -17.27 | -17.89 |          |
| 170 | -18.52 | -19.16 | -19.80 | -20.46 | -21.13 |          |
| 180 | -21.80 | -22.49 | -23.19 | -23.90 | -24.63 |          |
| 190 | -25.36 | -26.11 | -26.88 | -27.66 | -28.46 |          |
| 200 | -29.27 | -30.10 | -30.95 | -31.82 | -32.70 |          |
| 210 | -33.61 | -34.53 | -35.48 | -36.44 | -37.43 |          |
| 220 | -38.44 | -39.48 | -40.53 | -41.61 | -42.72 |          |
| 230 | -43.85 | -45.01 | -46.19 | -47.41 | -48.64 |          |
| 240 | -49.91 | -51.21 | -52.53 | -53.89 | -55.28 |          |
| 250 | -56.70 | -58.15 | -59.63 | -61.14 |        |          |

DEG C

E-381

CRS PHA T

Chg 2, 5 JUL 77

RUN 1757 0031CRS

MJS77 SERIAL NO..... MJS-3  
 MJS77 FUNCTION ..... CRS SUPP/REPL HEATER A TEMP  
 FDS TREESWITCH ID .. 29  
 FDS RANGE ..... 0-3 VOLTS  
 FDS SERIAL NO..... 1  
 SUBASSY REF NO..... 2021  
 SUBASSY SERIAL NO... 003  
 MEAS CALIB RANGE ... 60 TO -60 DEG C  
 MEAS CALIB TEMP .... -  
 XDUCER SERIAL NO.... -  
 XDUCER IMPEDANCE ... -  
 XDUCER CALIB DATE .. 6-28-76  
 DATA PREPARED BY ... GSFC  
 APPROVED BY ... J. OTTE  
 APPROVED BY ... R. ROTTER  
 RUN DATE ..... 1757 0031CRS  
 STANDARD DEVIATION . .44052287+00  
 COEFFICIENT A0 ..... .67625049+02  
 COEFFICIENT A1 ..... -.10565313+01  
 COEFFICIENT A2 ..... .53530554-02  
 COEFFICIENT A3 ..... -.12464208-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.30        | 39.4195       | .580481  |
| 30.00           | 43.74        | 30.6118       | -.611828 |
| 20.00           | 60.61        | 20.4783       | -.478339 |
| 10.00           | 82.93        | 9.7110        | .289041  |
| .00             | 110.37       | -.5346        | .534563  |
| -10.00          | 141.39       | -9.9747       | -.025335 |
| -20.00          | 173.09       | -19.5076      | -.492362 |
| -30.00          | 201.55       | -29.9138      | -.086205 |
| -40.00          | 224.04       | -40.5565      | .556489  |
| -50.00          | 239.72       | -49.7335      | -.266512 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | FRAME 15<br>8 |
|-----|--------|--------|--------|--------|---------------|
| 0   | 67.63  | 65.53  | 63.48  | 61.48  | 59.51         |
| 10  | 57.58  | 55.70  | 53.85  | 52.04  | 50.27         |
| 20  | 48.54  | 46.84  | 45.18  | 43.55  | 41.97         |
| 30  | 40.41  | 38.89  | 37.40  | 35.95  | 34.52         |
| 40  | 33.13  | 31.77  | 30.44  | 29.14  | 27.87         |
| 50  | 26.62  | 25.41  | 24.22  | 23.06  | 21.92         |
| 60  | 20.81  | 19.73  | 18.67  | 17.63  | 16.61         |
| 70  | 15.62  | 14.65  | 13.70  | 12.78  | 11.87         |
| 80  | 10.98  | 10.11  | 9.26   | 8.43   | 7.61          |
| 90  | 6.81   | 6.03   | 5.26   | 4.50   | 3.76          |
| 100 | 3.04   | 2.32   | 1.62   | .93    | .26           |
| 110 | -.41   | -1.07  | -1.72  | -2.36  | -2.99         |
| 120 | -3.61  | -4.23  | -4.84  | -5.45  | -6.05         |
| 130 | -6.64  | -7.23  | -7.82  | -8.41  | -8.99         |
| 140 | -9.57  | -10.15 | -10.73 | -11.31 | -11.89        |
| 150 | -12.48 | -13.06 | -13.65 | -14.24 | -14.84        |
| 160 | -15.44 | -16.04 | -16.65 | -17.27 | -17.89        |
| 170 | -18.52 | -19.16 | -19.80 | -20.46 | -21.13        |
| 180 | -21.80 | -22.49 | -23.19 | -23.90 | -24.63        |
| 190 | -25.36 | -26.11 | -26.88 | -27.66 | -28.46        |
| 200 | -29.27 | -30.10 | -30.95 | -31.82 | -32.70        |
| 210 | -33.61 | -34.53 | -35.48 | -36.44 | -37.43        |
| 220 | -38.44 | -39.48 | -40.53 | -41.61 | -42.72        |
| 230 | -43.85 | -45.01 | -46.19 | -47.41 | -48.64        |
| 240 | -49.91 | -51.21 | -52.53 | -53.89 | -55.28        |
| 250 | -56.70 | -58.15 | -59.63 | -61.14 |               |

DEG C

E-382

CRS HTA T

Chg 2, 5 JUL 77

RUN 1757 0031CRS

MJS77 SERIAL NO..... MJS-3  
MJS77 FUNCTION ..... CRS SUPP/REPL HEATER B TEMP

FDS TREESWITCH ID .. 29  
FDS RANGE ..... 0-3 VOLTS  
FDS SERIAL NO..... 1

SUBASSY REF NO..... 2021  
SUBASSY SERIAL NO... 003

MEAS CALIB RANGE ... 60 TO -60 DEG C  
MEAS CALIB TEMP .... -

XDUCER SERIAL NO.... -  
XDUCER IMPEDANCE ... -  
XDUCER CALIB DATE .. 6-28-76

DATA PREPARED BY ... GSFC  
APPROVED BY ... J. OTTE  
APPROVED BY ... R. ROTTER  
RUN DATE ..... 1757 0031CRS

STANDARD DEVIATION . .44052287+00

COEFFICIENT A0 ..... .67625049+02  
COEFFICIENT A1 ..... -.10565313+01  
COEFFICIENT A2 ..... .53530554-02  
COEFFICIENT A3 ..... -.12464208-04

| MEASURAND<br>EU | OUTPUT<br>DN | F(X)<br>PRIME | DELTA    |
|-----------------|--------------|---------------|----------|
| 40.00           | 31.30        | 39.4195       | .580481  |
| 30.00           | 43.74        | 30.6118       | -.611828 |
| 20.00           | 60.61        | 20.4783       | -.478339 |
| 10.00           | 82.93        | 9.7110        | .289041  |
| .00             | 110.37       | -.5346        | .534563  |
| -10.00          | 141.39       | -9.9747       | -.025335 |
| -20.00          | 173.09       | -19.5076      | -.492362 |
| -30.00          | 201.55       | -29.9138      | -.086205 |
| -40.00          | 224.04       | -40.5565      | .556489  |
| -50.00          | 239.72       | -49.7335      | -.266512 |

DATA NUMBER

|     | 0      | 2      | 4      | 6      | 8      | FRAME 19 |
|-----|--------|--------|--------|--------|--------|----------|
| 0   | 67.63  | 65.53  | 63.48  | 61.48  | 59.51  |          |
| 10  | 57.58  | 55.70  | 53.85  | 52.04  | 50.27  |          |
| 20  | 48.54  | 46.84  | 45.18  | 43.55  | 41.97  |          |
| 30  | 40.41  | 38.89  | 37.40  | 35.95  | 34.52  |          |
| 40  | 33.13  | 31.77  | 30.44  | 29.14  | 27.87  |          |
| 50  | 26.62  | 25.41  | 24.22  | 23.06  | 21.92  |          |
| 60  | 20.81  | 19.73  | 18.67  | 17.63  | 16.61  |          |
| 70  | 15.62  | 14.65  | 13.70  | 12.78  | 11.87  |          |
| 80  | 10.98  | 10.11  | 9.26   | 8.43   | 7.61   |          |
| 90  | 6.81   | 6.03   | 5.26   | 4.50   | 3.76   |          |
| 100 | 3.04   | 2.32   | 1.62   | .93    | .26    |          |
| 110 | -.41   | -1.07  | -1.72  | -2.36  | -2.99  |          |
| 120 | -3.61  | -4.23  | -4.84  | -5.45  | -6.05  |          |
| 130 | -6.64  | -7.23  | -7.82  | -8.41  | -8.99  |          |
| 140 | -9.57  | -10.15 | -10.73 | -11.31 | -11.89 |          |
| 150 | -12.48 | -13.06 | -13.65 | -14.24 | -14.84 |          |
| 160 | -15.44 | -16.04 | -16.65 | -17.27 | -17.89 |          |
| 170 | -18.52 | -19.16 | -19.80 | -20.46 | -21.13 |          |
| 180 | -21.80 | -22.49 | -23.19 | -23.90 | -24.63 |          |
| 190 | -25.36 | -26.11 | -26.88 | -27.66 | -28.46 |          |
| 200 | -29.27 | -30.10 | -30.95 | -31.82 | -32.70 |          |
| 210 | -33.61 | -34.53 | -35.48 | -36.44 | -37.43 |          |
| 220 | -38.44 | -39.48 | -40.53 | -41.61 | -42.72 |          |
| 230 | -43.85 | -45.01 | -46.19 | -47.41 | -48.64 |          |
| 240 | -49.91 | -51.21 | -52.53 | -53.89 | -55.28 |          |
| 250 | -56.70 | -58.15 | -59.63 | -61.14 |        |          |

DEG C

E-383

CRS HTB T

Chg 2, 5 JUL 77

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VOYAGER

SOFTWARE INTERFACE SPECIFICATION

SIS 4-7008-1, Revision D

Fixed Instrument SEDR

15 August 1985

APPROVALS

GENERATING PROGRAM

SEDRGEN

Cognizant Engineer \_\_\_\_\_  
Neil Toy

Cognizant Programmer \_\_\_\_\_  
Neil Toy

PRINCIPAL INVESTIGATORS

CONCURRENCE

\_\_\_\_\_  
Neil Toy

CONCURRENCES

Data Records System Engineer \_\_\_\_\_  
Neil Toy

Ground Data System/Software  
Engineer \_\_\_\_\_  
Robert E. Hill

Manager, GDS Engineering \_\_\_\_\_  
Allan Sacks

### SOFTWARE INTERFACE SPECIFICATION

|                     |                |                  |                                       |
|---------------------|----------------|------------------|---------------------------------------|
| GENERATING PROGRAM: | SEDRGEN        | USER PROGRAM:    | Fixed Instrument<br>PI SEDR Processor |
| COMPUTER SYSTEM:    | UNIVAC 1100/81 | COMPUTER SYSTEM: |                                       |

---

#### PURPOSE OF INTERFACE:

To provide the fixed or direct sensing instrument Principal Investigators (PI) with navigation and spacecraft orientation information during the periods when their experiment data were obtained.

---

#### INTERFACE DEVICE:

The SEDR data will be transmitted to the PIs via a 9-track magnetic tape which has been written at a density of 800 or 1600 bpi using odd lateral parity. Each SEDR tape will contain a single file termed "Fixed Instrument SEDR File".

---

#### DATA CODE:

The SEDR will be composed of 32-bit words which contains character, integer and floating point quantities. All character data will be Left Justified Space Filled (LJSF) in the standard IBM EBCDIC code. All integer quantities will be in the 2's complement form. The floating point words will be in the standard IBM format which is given below. In essence the tape will appear as if it had been written on an IBM 360. IBM 360 floating point word has the following 32-bit format:

Bit 0      1      7 8      31  
|SIGN| CHAR | FRACTION |

Where,

**SIGN** indicates the sign of the quantity represented by the floating point word. If SIGN=0, the quantity is positive. If SIGN=1, the quantity is negative.

**CHAR** indicates the characteristic or location of the hexadecimal point of the FRACTION portion of the word. This value is normalized to a hexadecimal value of 40 such that CHAR - 40 (hexadecimal arithmetic) locates the hexadecimal point to the right when positive and to the left when negative. The CHAR can also be considered to be a decimal scale factor which the FRACTION (when evaluated as a decimal) must be multiplied by to properly evaluate the quantity. Under this scheme, the

normalized value is 64 (decimal) and the scale factor is the (CHAR - 64)th power of 16.

FRACTION contains the significant digits of the quantity with the binary point located to the left of bit 8.

The following algorithm could be used to evaluate floating point quantities from the format:

$$\text{VALUE}_{10} = (1 - 2 * \text{SIGN}) * (\text{FRACTION}_{10}) * 16_{10} ** (\text{CHAR}_{10} - 64_{10})$$

---

#### RECORDING METHOD

UNIVAC 1100 System Library Routine, IOW (binary read/write routine)

---

#### DETAILED INTERFACE DEFINITION/FORMAT

The SEDRGEN program writes a 9-track magnetic tape at 800 bpi for the LBCP, ELS, PPS, PRA, RSS, and UVS experiments and at 1600 bpi for the CRS, IRIS, MAG and PWS experiments. All words will be 32 bits in length and all physical records except for the header record will contain the same number of words for any single SEDR. The attachments to this document describe the structure and content of the Fixed Instrument SEDR File.

- Attachment A Fixed Instrument SEDR File Layout
  - Attachment B Fixed Instrument SEDR Header Record Format
  - Attachment C Navigation Data Block Format for Launch Period
  - Attachment D Navigation Data Block Format for Cruise Periods
  - Attachment E Navigation Data Block Format for Jupiter Encounter
  - Attachment F Navigation Data Block Format for Saturn Encounter
  - Attachment G Pointing Vector Data Block Format
  - Attachment H Navigation Data Block Format for Extended Mission Cruise (post Saturn encounter cruise periods)
  - Attachment I Navigation Data Block Format for Uranus Encounter
- 

#### DEFINITION OF TERMS

- Cartesian State** Cartesian position and velocity components in the following order: X-position, Y-position, Z-position, X-velocity, Y-velocity, and Z-velocity.
- Celestial Clock and Cone Angles** Clock and cone angles centered at the S/C with respect to the sun - S/C - Canopus (ABC) reference system.
- Equinox** Refers to the vernal equinox; ie., for the planets the vernal equinox is defined as the axis from the center of the planet to the ascending node of the planet's orbit through the planet's equatorial plane.
- Longitudes** The longitude angles given on the SEDR for the planets Systems and satellite will conform to the International Astronomical Union (IAU) conventions. All longitude

angles pertaining to Jupiter will be given relative to the System I Prime Meridian. The SEDR will also contain conversion or rotation angles such that longitudes can also be obtained relative to the System II and System III Prime Meridians. This document will not attempt to define all the longitude systems of the planets and satellites that will be represented on the SEDR. However, reference to documentation which contains descriptions of the Jupiter, Saturn and Uranus Systems are given below:

Jupiter System I - Explanatory Supplement to the Ephemeris or JEL Technical Report 32-1508, dated January 15, 1971 (available upon request).

Jupiter System II - Same as Jupiter System I.

Jupiter System III - The SEDR uses System III (1965.0)

Saturn System - JEL Technical Report 32-1508, dated January 15, 1971 (available upon request).

Uranus System - JEL Interoffice Memorandum, Voyager-NAV-84-42, "Trajectory/Navigation Data Package for Nominal Voyager 2 Uranus-System Flyby", dated August 31, 1984 (available upon request).

## List of Acronyms

|        |   |
|--------|---|
| BPI    | Bits per inch   |
| C      | Character quantity  |
| CRS    | Cosmic Ray Subsystem  |
| Deg    | Degrees   |
| Dim    | Dimensionless   |
| DPTRAJ | Double Precision Trajectory Program                           |
| E      | Floating point quantity                                       |
| FDSC   | Flight Data Subsystem count                                   |
| FIP    | Fixed Instrument Pointing                                     |
| GMT    | Greenwich Mean Time   |
| HHMMSS | Hours-minutes-seconds   |
| I      | Integer quantity  |
| IAU    | International Astronomical Union                              |
| IPPS   | Instrument Pointing Program Set                               |
| IRG    | Inter-record gap  |
| IRIS   | Infrared Interferometer Spectrometer and Radiometer Subsystem |
| JPL    | Jet Propulsion Laboratory                                     |
| Km     | Kilometer   |
| Km/sec | Kilometers per second   |
| LECP   | Low Energy Charged Particle Subsystem                         |
| LJSF   | Left Justified Space Filled                                   |
| MMDDYY | Month-day-year  |
| MOD    | Modulo  |
| Msec   | Milliseconds  |
| PI     | Principal Investigator  |

|         |  |
|---------|--|
| PLS     | Plasma Subsystem   |
| PPS     | Photopolarimeter Subsystem                               |
| PRA     | Planetary Radio Astronomy Subsystem                      |
| PWS     | Plasma Science Subsystem                                 |
| RSS     | Radio Science Subsystem                                  |
| SCET    | Spacecraft event time                                    |
| Sec     | Seconds  |
| SEDR    | Supplementary Experiment Data Records                    |
| SEDRGEN | Supplementary Experiment Data Records Generation Program |
| S/C     | Spacecraft   |
| UTC     | Coordinated Universal Time                               |
| UVS     | Ultraviolet Spectrometer Subsystem                       |

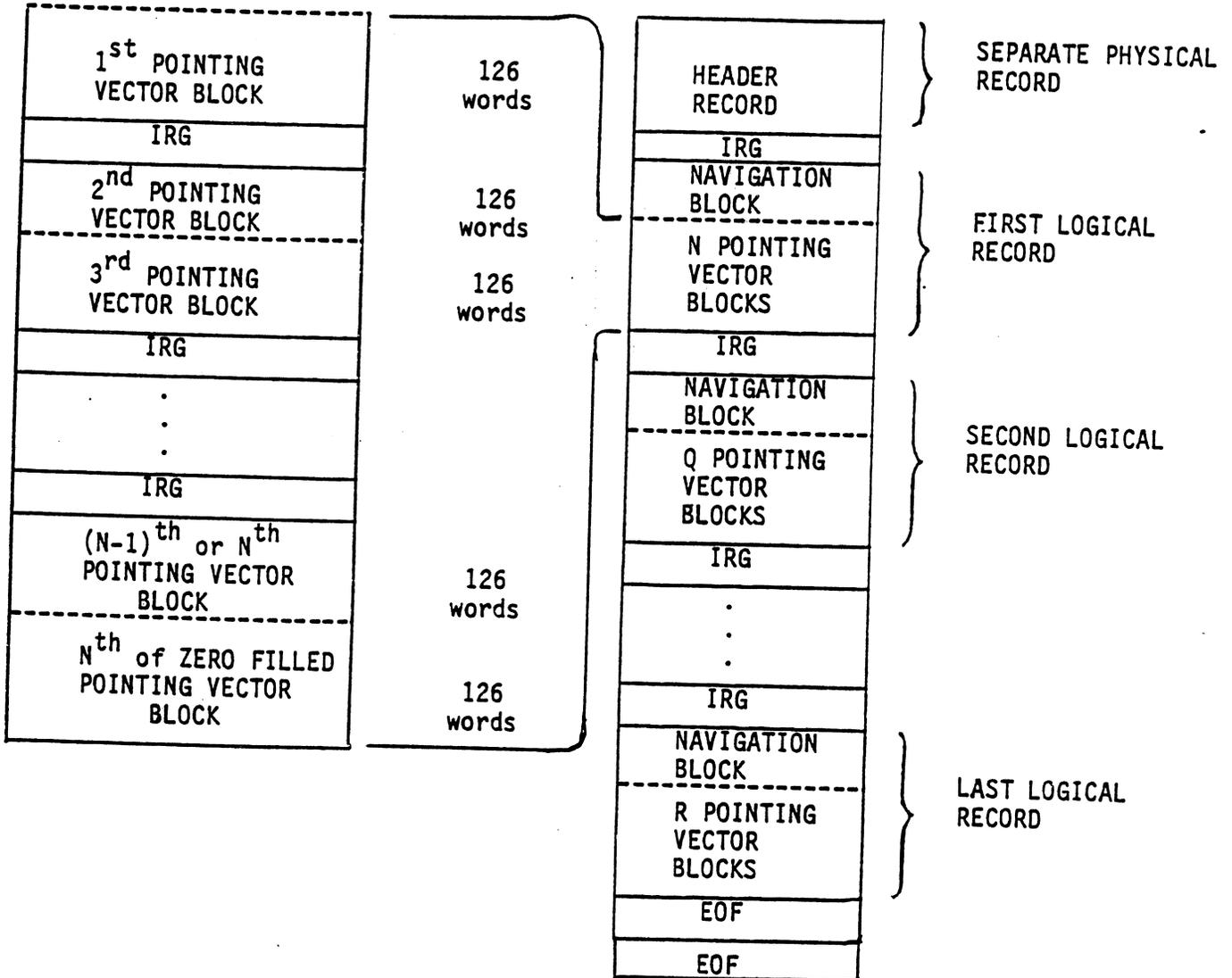
**ATTACHMENT A**

**Fixed Instrument SEDR  
File Layout**

# ATTACHMENT A

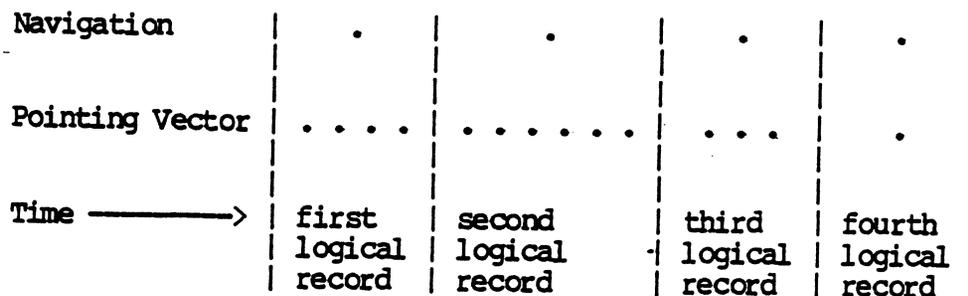
## Fixed Instrument SEDR File Layout

The following SEDR file (tape) layout represents the common file structure that will be supplied to fixed instrument Principal Investigators (PIs) of the Voyager mission.



Each logical record will contain one navigation data block (one set of navigation data effective at a particular time) and all pointing vector data blocks associated with it. This association is determined by time such that the times of the pointing vector blocks in any logical record are closer to that logical record's navigation block time than any other navigation block time on the SEDR. The following figure illustrates how SEDR logical records

would be formed given an arbitrary set of navigation and pointing vector times. Note that the navigation block is always the first data in the logical record even though some of the pointing vector blocks may have earlier times. However, the navigation and pointing vector blocks taken as individual sets will always be in increasing time order.



Each logical record will be composed of an integral number of physical records. Also, each physical record will contain an integral number of 126 word logical blocks. The number of these blocks for each physical record will be determined from the size of the navigation data block and one pointing vector block. For launch, cruise, and Saturn encounter, the navigation data block occupies one logical block while the Jupiter and Uranus encounter navigation blocks require two logical blocks. The pointing vector block is mission phase independent and always occupies one logical block. Therefore, the physical record size for launch, cruise, and Saturn encounter is 2 logical blocks or 252 words while Jupiter or Uranus encounter requires 3 logical blocks or 378 words. When multiple pointing vector blocks exist in a logical record, these data are filled into as many additional physical records as are required to contain the logical record. Each pointing vector block will contain a continuation bit which indicates if that pointing vector block is the last block in the logical record. If the last physical record is not evenly filled with pointing vector blocks, the remainder of the record will be zero filled. The left-hand portion of the file format presented at the start of this attachment illustrates the physical record - logical record structure/relationship for the launch, cruise, or Saturn encounter format. The Jupiter and Uranus encounter formats would be similar except that the physical records would contain three 126 word blocks instead of two.

ATTACHMENT B

Fixed Instrument SEDR  
Header Record Format

ATTACHMENT B

Fixed Instrument SEDR Header Record Format

| WORD  | DESCRIPTION   | UNITS   | TYPE |
|-------|---|---|------|
| 1     | Project Identification  | 'VOY 77'  | C    |
| 2     | File Identification   | 'SEDR'  | C    |
| 3     | S/C Identification<br>0 = Flt 2, 1 = Flt 1, 2 = PTM,<br>4 = Sim 1, 5 = Sim 2, Others = Unused | d/m   | I    |
| 4-5   | SEDR Tape Identification  | see<br>page 12  | C    |
| 6     | SEDR File Generation Date   | MMDDYY  | I    |
| 7     | SEDR File Generation Time   | HHMMSS  | I    |
| 8-9   | Pointing Vector (FIP) Tape Identification   | JPL<br>Facility<br>Number   | C    |
| 10    | FIP File Generation Data  | MMDDYY  | I    |
| 11    | FIP File Generation Time  | HHMMSS  | I    |
| 12-13 | Navigation (DPTRAJ Save Tape) Tape Identification   | JPL<br>Facility<br>Number   | C    |
| 14-15 | Navigation Data Block Identification, i.e., Launch, Cruise, Jupiter<br>or Saturn              | 'LAUNCH'<br>'CRUISE'<br>'JUPITE'<br>'SATURN'<br>'XCRUISE'<br>'URANUS' | C    |

ATTACHMENT B

Fixed Instrument SEDR Header Record Format

| WORD  | DESCRIPTION                               | UNITS | TYPE |
|-------|---|-------|------|
| 16-19 | Same as 12-15 for Second DPTRAJ Save Tape |       |      |
| 20-23 | Same as 12-15 for Third DPTRAJ Save Tape  |       |      |
| 24-27 | Same as 12-15 for Fourth DPTRAJ Save Tape |       |      |
| 28-45 | Spares                                    |       |      |
|       |   |       |      |
|       |   |       |      |
|       |   |       |      |
|       |   |       |      |
|       |   |       |      |
|       |   |       |      |
|       |   |       |      |
|       |   |       |      |

## SEDR TAPE IDENTIFICATION

Each SEDR tape is labelled with an eight character alphanumeric identifier which indicates the SEDR type, the experiment/instrument identification, the spacecraft identification and the mission phase. The identifier has the following general form:

A B B I J J K K

A indicates the SEDR type. A = S, indicates a fixed instrument SEDR and A = F, indicates a scan platform or footprint SEDR.

BB indicates the experiment/instrument identification according to the following list:

| <u>BB</u> | <u>Experiment/Instrument</u>         |
|-----------|--------------------------------------|
| CR        | Cosmic Ray                           |
| IR        | Infrared Interferometer Spectrometer |
| LE        | Low Energy Charged Particles         |
| MA        | Magnetometer                         |
| PL        | Plasma                               |
| PP        | Photopolarimeter                     |
| PR        | Planetary Radio Astronomy            |
| PW        | Plasma Wave                          |
| RS        | Radio Science                        |
| UV        | Ultra Violet Spectrometer            |

I indicates the spacecraft identification. I = 0 is for the FLT-2 spacecraft and I = 1 is for the FLT-1 spacecraft.

JJ indicates the mission phase according to the following list:

| <u>JJ</u> | <u>Mission Phase</u>                    |
|-----------|---|
| 00-09     | Unused                                  |
| 10-19     | Launch                                  |
| 20-29     | Earth to Jupiter Cruise                 |
| 30-39     | Jupiter Encounter                       |
| 40-49     | Jupiter to Saturn Cruise                |
| 50-59     | Saturn Encounter                        |
| 60-69     | Post Saturn or Saturn to Uranus Cruise  |
| 70-79     | Uranus Encounter                        |
| 80-89     | Post Uranus or Uranus to Neptune Cruise |
| 90-99     | Neptune Encounter                       |

KK Indicates the SEDR serial number within each mission phase.

**ATTACHMENT C**

**Navigation Data Block Format  
for Launch Period**

## Navigation Data Block Format for Launch Period

| WORD  | DESCRIPTION  | UNITS               | TYPE |
|-------|--|---------------------|------|
| 1     | SCE GMT Year of Navigation Data Block  | years,<br>AD        | I    |
| 2     | SCE GMT Day of Navigation Data Block   | day of<br>year      | I    |
| 3     | SCE GMT Hour of Navigation Data Block  | hour of<br>day      | I    |
| 4     | SCE GMT Minute of Navigation Data Block  | minute of<br>hour   | I    |
| 5     | SCE GMT Second of Navigation Data Block  | second<br>of minute | I    |
| 6     | SCE GMT Millisecond (msec) of Navigation Data Block                                    | msec of<br>second   | I    |
| 7-12  | Cartesian State of S/C, Earth Centered, Earth Mean Ecliptic<br>and Equinox of 1950.0   | km<br>km/sec        | E    |
| 13-18 | Cartesian State of S/C, Sun Centered, Earth Mean Ecliptic<br>and Equinox of 1950.0     | km<br>km/sec        | E    |
| 19-24 | Cartesian State of S/C, Jupiter Centered, Earth Mean Ecliptic<br>and Equinox of 1950.0 | km<br>km/sec        | E    |
| 25-30 | Cartesian State of S/C, Saturn Centered, Earth Mean Ecliptic<br>and Equinox of 1950.0  | km<br>km/sec        | E    |
| 31-36 | Cartesian State of Earth, Sun Centered, Earth Mean Ecliptic<br>and Equinox of 1950.0   | km<br>km/sec        | E    |

Navigation Data Block Format for Launch Period

| WORD  | DESCRIPTION   | UNITS  | TYPE |
|-------|---|--------|------|
| 37-42 | Cartesian State of Jupiter, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0 | km     | E    |
| 43-48 | Cartesian State of Saturn, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0  | km/sec | E    |
| 49    | Range Earth - S/C   | km     | E    |
| 50    | Range Earth - Sun   | km     | E    |
| 51    | Range Sun - S/C   | km     | E    |
| 52    | Range Jupiter - S/C   | km     | E    |
| 53    | Range Saturn - S/C  | km     | E    |
| 54    | Range Sun - Jupiter   | km     | E    |
| 55    | Range Sun - Saturn  | km     | E    |
| 56    | Angle Earth - Sun - S/C   | deg    | E    |
| 57    | Angle Sun - S/C - Earth (Celestial Cone Angle of Earth)                             | deg    | E    |

## Navigation Data Block Format for Launch Period

| WORD  | DESCRIPTION  | UNITS | TYPE |
|-------|--|-------|------|
| 58    | Angle Sun - Earth - S/C  | deg   | E    |
| 59    | Angle Jupiter - Sun - S/C  | deg   | E    |
| 60    | Angle Sun - S/C - Jupiter (Celestial Cone Angle of Jupiter)                                      | deg   | E    |
| 61    | Angle Sun - Jupiter - S/C  | deg   | E    |
| 62    | Angle Saturn - Sun - S/C   | deg   | E    |
| 63    | Angle Sun - S/C - Saturn (Celestial Cone Angle of Saturn)  | deg   | E    |
| 64    | Angle Sun - Saturn - S/C   | deg   | E    |
| 65    | Celestial Clock Angle of Earth   | deg   | E    |
| 66    | Celestial Clock Angle of Jupiter   | deg   | E    |
| 67    | Celestial Clock Angle of Saturn  | deg   | E    |
| 68-69 | Right Ascension and Declination of S/C, Earth Centered, Earth Mean Equator and Equinox of 1950.0 | deg   | E    |

## Navigation Data Block Format for Launch Period

| WORD  | DESCRIPTION  | UNITS | TYPE |
|-------|--|-------|------|
| 70-71 | Right Ascension and Declination of Sun, Earth Centered, Earth Mean Equator and Equinox of 1950.0     | deg   | E    |
| 72-73 | Right Ascension and Declination of Jupiter, Earth Centered, Earth Mean Equator and Equinox of 1950.0 | deg   | E    |
| 74-75 | Right Ascension and Declination of Saturn, Earth Centered, Earth Mean Equator and Equinox of 1950.0  | deg   | E    |
| 76-77 | Right Ascension and Declination of S/C, Jupiter Centered Jupiter True Equinox and Equator of Date    | deg   | E    |
| 78-79 | Right Ascension and Declination of Sun, Jupiter Centered, Jupiter True Equinox and Equator of Date   | deg   | E    |
| 80-81 | Right Ascension and Declination of Earth, Jupiter Centered, Jupiter True Equinox and Equator of Date | deg   | E    |
| 82-83 | Right Ascension and Declination of Io, Jupiter Centered, Jupiter True Equinox and Equator of Date    | deg   | E    |
| 84-85 | Right Ascension and Declination of S/C, Saturn Centered, Saturn Mean Equinox and Equator of 1950.0   | deg   | E    |
| 86-87 | Spares   |       |      |
| 88-89 | Spares   |       |      |
| 90-91 | Celestial Latitude and Longitude of S/C, Sun Centered, Earth True Equinox and Ecliptic of Date       | deg   | E    |

Navigation Data Block Format for Launch Period

| WORD    | DESCRIPTION  | UNITS | TYPE |
|---------|--|-------|------|
| 92-93   | Celestial Latitude and Longitude of Earth, Sun Centered,<br>Earth True Equinox and Ecliptic of Date            | deg   | E    |
| 94-95   | Celestial Latitude and Longitude of Jupiter, Sun Centered,<br>Earth True Equinox and Ecliptic of Date          | deg   | E    |
| 96-97   | Celestial Latitude and Longitude of Saturn, Sun Centered,<br>Earth True Equinox and Ecliptic of Date           | deg   | E    |
| 98-99   | Right Ascension and Declination of S/C, Sun Centered,<br>Sun True Equinox and Equator of Date                  | deg   | E    |
| 100-101 | Right Ascension and Declination of Earth, Sun Centered,<br>Sun True Equinox and Equator of Date                | deg   | E    |
| 102-103 | Right Ascension and Declination of Jupiter, Sun Centered,<br>Sun True Equinox and Equator of Date              | deg   | E    |
| 104-105 | Right Ascension and Declination of Saturn, Sun Centered,<br>Sun True Equinox and Equator of Date               | deg   | E    |
| 106     | Hour Angle of Jupiter System III Prime Meridian, Jupiter<br>Centered, Jupiter True Equinox and Equator of Date | deg   | E    |
| 107-126 | Spares   |       |      |
|         |  |       |      |
|         |  |       |      |

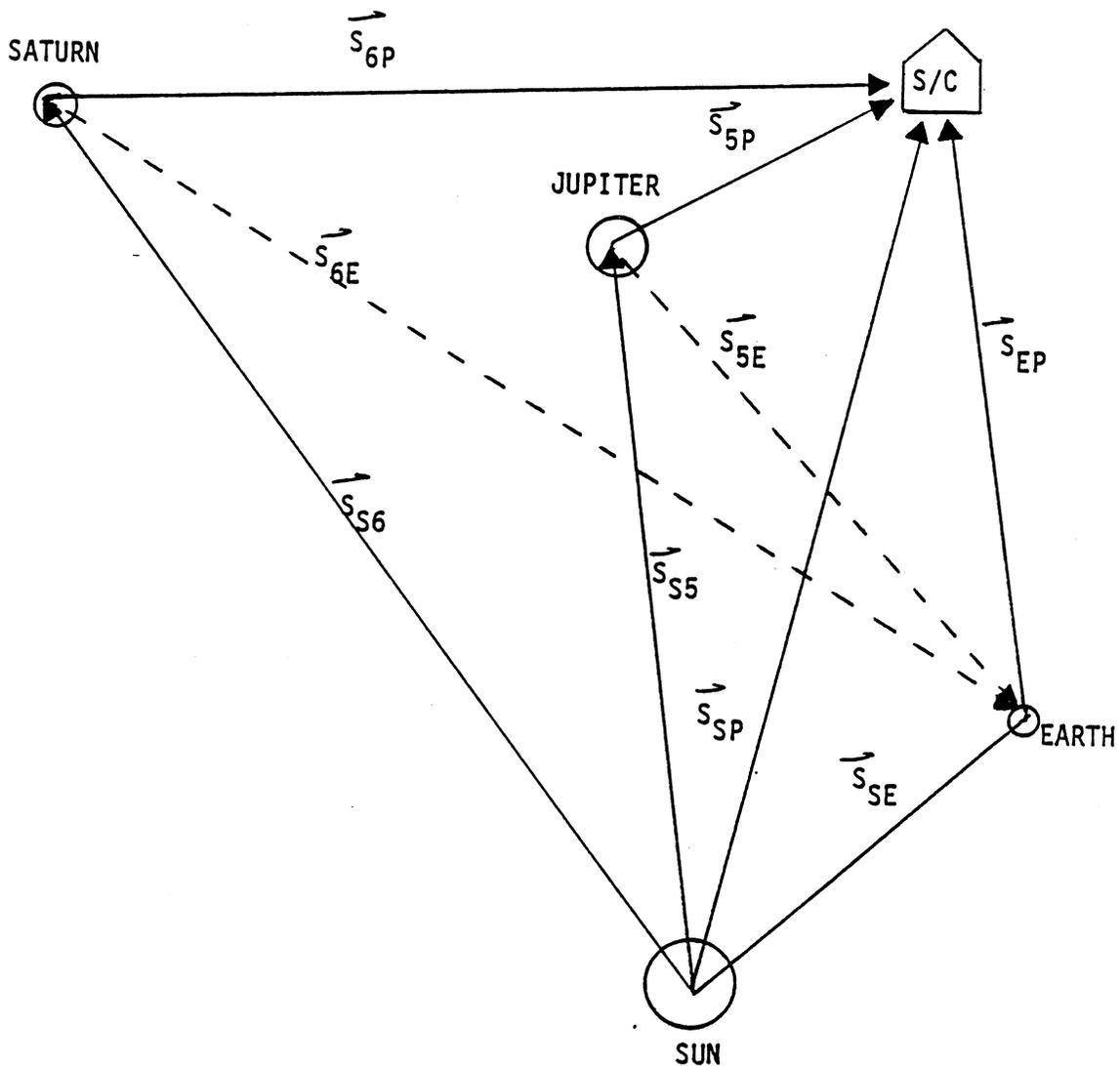


Figure C-1 Earth Mean Ecliptic and Equinox of 1950.0 (ECL50) Launch SEDR State Vectors

Nomenclature  $\vec{S}$  refers to State Vector (Position and Velocity Components) with the subscripts AB, where, A is the reference or "From" body and B is the "To" body. The following body definitions are used; S-Sun, P-S/C or Probe, E-Earth, 5-Jupiter and 6-Saturn.

Note that the Earth State with respect to Jupiter and Saturn ( $\vec{S}_{5E}$  and  $\vec{S}_{6E}$  - dashed vectors in Figure) will not be provided. These states can be simply derived, if desired, by the PI by vector subtraction of the Sun to Earth State ( $\vec{S}_{SE}$ ) and the Sun to Jupiter and the Sun to Saturn States ( $\vec{S}_{S5}$  and  $\vec{S}_{S6}$ ).

**ATTACHMENT D**

**Navigation Data Block Format  
for Cruise Periods**

## Navigation Data Block Format for Cruise Periods

| WORD  | DESCRIPTION   | UNITS               | TYPE |
|-------|---|---------------------|------|
| 1     | SCE GMT Year of Navigation Data Block   | years,<br>AD        | I    |
| 2     | SCE GMT Day of Navigation Data Block  | day of<br>year      | I    |
| 3     | SCE GMT Hour of Navigation Data Block   | hour of<br>day      | I    |
| 4     | SCE GMT Minute of Navigation Data Block   | minute of<br>hour   | I    |
| 5     | SCE GMT Second of Navigation Data Block   | second of<br>minute | I    |
| 6     | SCE GMT Millisecond (msec) of Navigation Data Block                                 | msec of<br>second   | I    |
| 7-12  | Cartesian State of S/C, Earth Centered, Earth Mean Ecliptic and Equinox of 1950.0   | km<br>km/sec        | E    |
| 13-18 | Cartesian State of S/C, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0     | km<br>km/sec        | E    |
| 19-24 | Cartesian State of S/C, Jupiter Centered, Earth Mean Ecliptic and Equinox of 1950.0 | km<br>km/sec        | E    |
| 25-30 | Cartesian State of S/C, Saturn Centered, Earth Mean Ecliptic and Equinox of 1950.0  | km<br>km/sec        | E    |
| 31-36 | Cartesian State of Earth, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0   | km<br>km/sec        | E    |

Navigation Data Block Format for Cruise Periods

| WORD  | DESCRIPTION   | UNITS        | TYPE |
|-------|---|--------------|------|
| 37-42 | Cartesian State of Jupiter, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0 | km<br>km/sec | E    |
| 43-48 | Cartesian State of Saturn, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0  | km<br>km/sec | E    |
| 49    | Range Earth - S/C   | km           | E    |
| 50    | Range Earth - Sun   | km           | E    |
| 51    | Range Sun - S/C   | km           | E    |
| 52    | Range Jupiter - S/C   | km           | E    |
| 53    | Range Saturn - S/C  | km           | E    |
| 54    | Range Sun - Jupiter   | km           | E    |
| 55    | Range Sun - Saturn  | km           | E    |
| 56    | Angle Earth - Sun - S/C   | deg          | E    |
| 57    | Angle Sun - S/C - Earth (Celestial Cone Angle of Earth)                             | deg          | E    |

ATTACHMENT D

Navigation Data Block Format for Cruise Periods

| WORD  | DESCRIPTION  | UNITS | TYPE |
|-------|--|-------|------|
| 58    | Angle Sun - Earth - S/C  | deg   | E    |
| 59    | Angle Jupiter - Sun - S/C  | deg   | E    |
| 60    | Angle Sun - S/C - Jupiter (Celestial Cone Angle of Jupiter)                                      | deg   | E    |
| 61    | Angle Sun - Jupiter - S/C  | deg   | E    |
| 62    | Angle Saturn - Sun - S/C   | deg   | E    |
| 63    | Angle Sun - S/C - Saturn (Celestial Cone Angle of Saturn)  | deg   | E    |
| 64    | Angle Sun - Saturn - S/C   | deg   | E    |
| 65    | Celestial Clock Angle of Earth   | deg   | E    |
| 66    | Celestial Clock Angle of Jupiter   | deg   | E    |
| 67    | Celestial Clock Angle of Saturn  | deg   | E    |
| 68-69 | Right Ascension and Declination of S/C, Earth Centered, Earth Mean Equator and Equinox of 1950.0 | deg   | E    |

## Navigation Data Block Format for Cruise Periods

| WORD  | DESCRIPTION  | UNITS | TYPE |
|-------|--|-------|------|
| 70-71 | Right Ascension and Declination of Sun, Earth Centered, Earth Mean Equator and Equinox of 1950.0     | deg   | E    |
| 72-73 | Right Ascension and Declination of Jupiter, Earth Centered, Earth Mean Equator and Equinox of 1950.0 | deg   | E    |
| 74-75 | Right Ascension and Declination of Saturn, Earth Centered, Earth Mean Equator and Equinox of 1950.0  | deg   | E    |
| 76-77 | Right Ascension and Declination of S/C, Jupiter Centered, Jupiter True Equinox and Equator of Date   | deg   | E    |
| 78-79 | Right Ascension and Declination of Sun, Jupiter Centered, Jupiter True Equinox and Equator of Date   | deg   | E    |
| 80-81 | Right Ascension and Declination of Earth, Jupiter Centered, Jupiter True Equinox and Equator of Date | deg   | E    |
| 82-83 | Right Ascension and Declination of Io, Jupiter Centered, Jupiter True Equinox and Equator of Date    | deg   | E    |
| 84-85 | Right Ascension and Declination of S/C, Saturn Centered, Saturn True Equinox and Equator of Date     | deg   | E    |
| 86-87 | Right Ascension and Declination of Sun, Saturn Centered, Saturn True Equinox and Equator of Date     | deg   | E    |
| 88-89 | Right Ascension and Declination of Earth, Saturn Centered, Saturn True Equinox and Equator of Date   | deg   | E    |
| 90-91 | Celestial Latitude and Longitude of S/C, Sun Centered, Earth True Equinox and Ecliptic of Date       | deg   | E    |

ATTACHMENT D

Navigation Data Block Format for Cruise Periods

| WORD    | DESCRIPTION  | UNITS | TYPE |
|---------|--|-------|------|
| 92-93   | Celestial Latitude and Longitude of Earth, Sun Centered,<br>Earth True Equinox and Ecliptic of Date            | deg   | E    |
| 94-95   | Celestial Latitude and Longitude of Jupiter, Sun Centered,<br>Earth True Equinox and Ecliptic of Date          | deg   | E    |
| 96-97   | Celestial Latitude and Longitude of Saturn, Sun Centered,<br>Earth True Equinox and Ecliptic of Date           | deg   | E    |
| 98-99   | Right Ascension and Declination of S/C, Sun Centered,<br>Sun True Equinox and Equator of Date                  | deg   | E    |
| 100-101 | Right Ascension and Declination of Earth, Sun Centered,<br>Sun True Equinox and Equator of Date                | deg   | E    |
| 102-103 | Right Ascension and Declination of Jupiter, Sun Centered,<br>Sun True Equinox and Equator of Date              | deg   | E    |
| 104-105 | Right Ascension and Declination of Saturn, Sun Centered,<br>Sun True Equinox and Equator of Date               | deg   | E    |
| 106     | Hour Angle of Jupiter System III Prime Meridian, Jupiter<br>Centered, Jupiter True Equinox and Equator of Date | deg   | E    |
| 107-126 | Spares   |       |      |
|         |  |       |      |
|         |  |       |      |

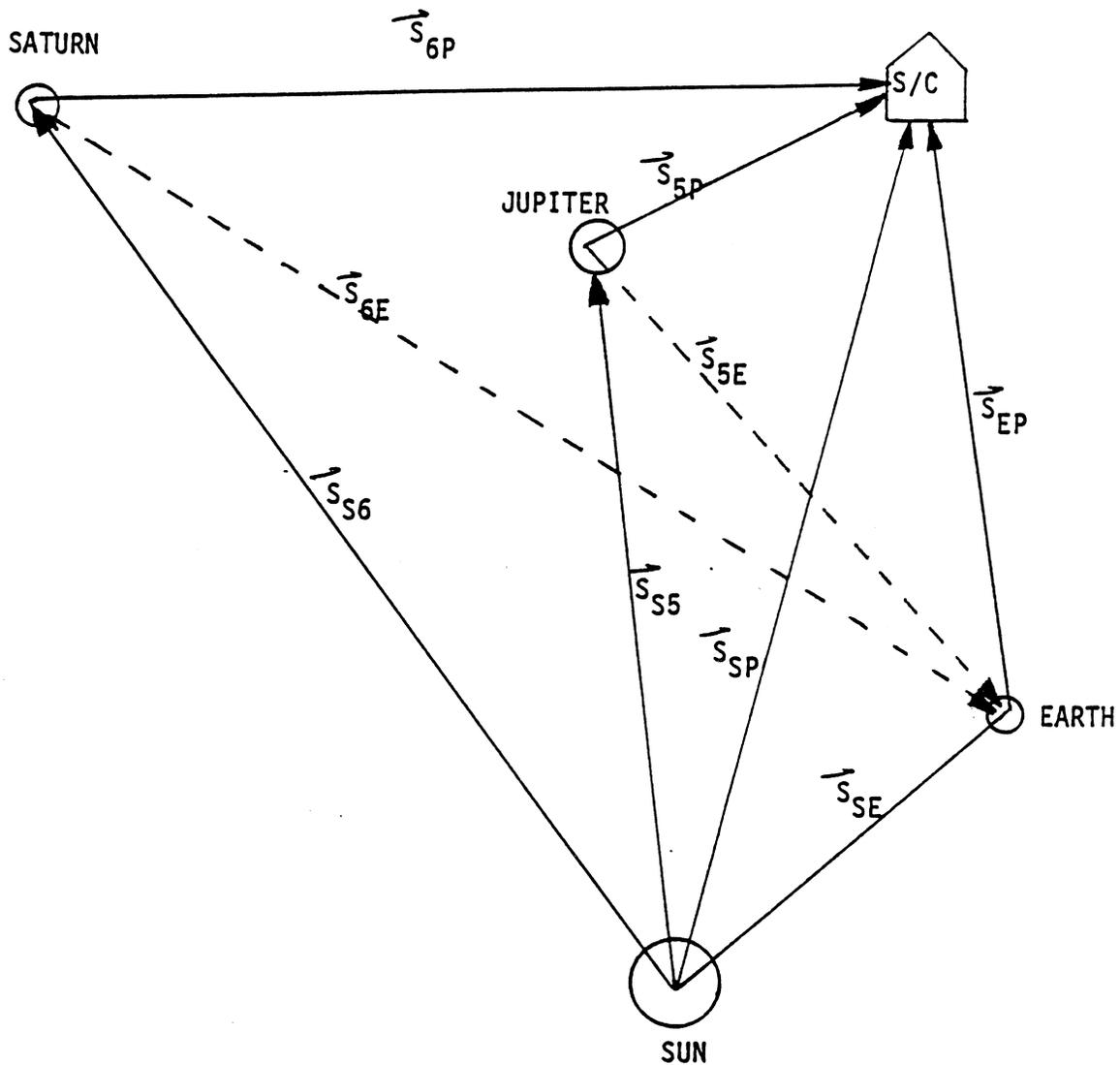


Figure D-1 Earth Mean Ecliptic and Equinox of 1950.0 (ECL50) Cruise SEDR State Vectors

Nomenclature  $\vec{S}$  refers to State Vector (Position and Velocity Components) with the subscripts AB, where, A is the reference or "From" body and B is the "To" body. The following body definitions are used; S-Sun, P-S/C or Probe, E-Earth, 5-Jupiter and 6-Saturn

Note that the Earth State with respect to Jupiter and Saturn ( $\vec{S}_{5E}$  and  $\vec{S}_{6E}$  - dashed vectors in Figure) will not be provided. These states can be simply derived, if desired, by the PI by vector subtraction of the Sun to Earth State ( $\vec{S}_{SE}$ ) and the Sun to Jupiter and the Sun to Saturn States ( $\vec{S}_{S5}$  and  $\vec{S}_{S6}$ ).

**ATTACHMENT E**

**Navigation Data Block Format  
for Jupiter Encounter**

## Navigation Data Block Format for Jupiter Encounter

| WORD  | DESCRIPTION  | UNITS               | TYPE |
|-------|--|---------------------|------|
| 1     | SCE GMT Year of Navigation Data Block  | years,<br>AD        | I    |
| 2     | SCE GMT Day of Navigation Data Block   | day of<br>year      | I    |
| 3     | SCE GMT Hour of Navigation Data Block  | hour of<br>day      | I    |
| 4     | SCE GMT Minute of Navigation Data Block  | minute<br>of hour   | I    |
| 5     | SCE GMT Second of Navigation Data Block  | second<br>of minute | I    |
| 6     | SCE GMT Millisecond (msec) of Navigation Data Block                                    | msec of<br>second   | I    |
| 7-12  | Cartesian State of S/C, Earth Centered, Earth Mean Ecliptic and<br>Equinox of 1950.0   | km<br>km/sec        | E    |
| 13-18 | Cartesian State of S/C, Sun Centered, Earth Mean Ecliptic and<br>Equinox of 1950.0     | km<br>km/sec        | E    |
| 19-24 | Cartesian State of S/C, Jupiter Centered, Earth Mean Ecliptic<br>and Equinox of 1950.0 | km<br>km/sec        | E    |
| 25-30 | Cartesian State of S/C, Io Centered, Earth Mean Ecliptic and<br>Equinox of 1950.0      | km<br>km/sec        | E    |
| 31-36 | Cartesian State of S/C, Europa Centered, Earth Mean Ecliptic<br>and Equinox of 1950.0  | km<br>km/sec        | E    |

## Navigation Data Block Format for Jupiter Encounter

| WORD   | DESCRIPTION  | UNITS        | TYPE |
|--------|--|--------------|------|
| 37-42  | Cartesian State of S/C, Ganymede Centered, Earth Mean Ecliptic and Equinox of 1950.0             | km<br>km/sec | E    |
| 43-48  | Cartesian State of S/C, Callisto Centered, Earth Mean Ecliptic and Equinox of 1950.0             | km<br>km/sec | E    |
| 49-54  | Cartesian State of Earth, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0                | km<br>km/sec | E    |
| 55-60  | Cartesian State of Jupiter, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0              | km<br>km/sec | E    |
| 61-66  | Cartesian State of Earth, Jupiter Centered, Earth Mean Ecliptic and Equinox of 1950.0            | km<br>km/sec | E    |
| 67-72  | Cartesian State of Io, Jupiter Centered, Earth Mean Ecliptic and Equinox of 1950.0               | km<br>km/sec | E    |
| 73-78  | Cartesian State of Europa, Jupiter Centered, Earth Mean Ecliptic and Equinox of 1950.0           | km<br>km/sec | E    |
| 79-84  | Cartesian State of Ganymede, Jupiter Centered, Earth Mean Ecliptic and Equinox of 1950.0         | km<br>km/sec | E    |
| 85-90  | Cartesian State of Callisto, Jupiter Centered, Earth Mean Ecliptic and Equinox of 1950.0         | km<br>km/sec | E    |
| 91-96  | Cartesian State of S/C, Jupiter Centered, Jupiter Mean Orbit and Prime Meridian in Sun Direction | km<br>km/sec | E    |
| 97-102 | Cartesian State of Io, Jupiter Centered, Jupiter Mean Orbit and Prime Meridian in Sun Direction  | km<br>km/sec | E    |

## Navigation Data Block Format for Jupiter Encounter

| WORD    | DESCRIPTION  | UNITS        | TYPE |
|---------|--|--------------|------|
| 103-108 | Cartesian State of Europa, Jupiter Centered, Jupiter Mean Orbit and Prime Meridian in Sun Direction        | km<br>km/sec | E    |
| 109-114 | Cartesian State of Ganymede, Jupiter Centered, Jupiter Mean Orbit and Prime Meridian in Sun Direction      | km<br>km/sec | E    |
| 115-120 | Cartesian State of Callisto, Jupiter Centered, Jupiter Mean Orbit and Prime Meridian in Sun Direction      | km<br>km/sec | E    |
| 121-126 | Cartesian State of S/C, Jupiter Centered, Jupiter System I True Prime Meridian and Equator of Date         | km<br>km/sec | E    |
| 127-129 | Cartesian Position of Io, Jupiter Centered, Jupiter System I True Prime Meridian and Equator of Date       | km           | E    |
| 130-132 | Cartesian Position of Europa, Jupiter Centered, Jupiter System I True Prime Meridian and Equator of Date   | km           | E    |
| 133-135 | Cartesian Position of Ganymede, Jupiter Centered, Jupiter System I True Prime Meridian and Equator of Date | km           | E    |
| 136-138 | Cartesian Position of Callisto, Jupiter Centered, Jupiter System I True Prime Meridian and Equator of Date | km           | E    |
| 139-144 | Cartesian State of S/C, Jupiter Centered, Jupiter System III True Prime Meridian and Equator of Date       | km<br>km/sec | E    |
| 145-147 | Cartesian Position of Io, Jupiter Centered, Jupiter System III True Prime Meridian and Equator of Date     | km           | E    |
| 148-150 | Cartesian Position of Europa, Jupiter Centered, Jupiter System III True Prime Meridian and Equator of Date | km           | E    |

## Navigation Data Block Format for Jupiter Encounter

| WORD    | DESCRIPTION  | UNITS | TYPE |
|---------|--|-------|------|
| 151-153 | Cartesian Position of Ganymede, Jupiter Centered, Jupiter System III True Prime Meridian and Equator of Date | km    | E    |
| 154-156 | Cartesian Position of Callisto, Jupiter Centered, Jupiter System III True Prime Meridian and Equator of Date | km    | E    |
| 157-159 | Jupiter Latitude, System I Longitude and System III Longitude of S/C   | deg   | E    |
| 160-162 | Jupiter Latitude, System I Longitude and System III Longitude of Io  | deg   | E    |
| 163-165 | Jupiter Latitude, System I Longitude and System III Longitude of Europa                                      | deg   | E    |
| 166-168 | Jupiter Latitude, System I Longitude and System III Longitude of Ganymede                                    | deg   | E    |
| 169-171 | Jupiter Latitude, System I Longitude and System III Longitude of Callisto                                    | deg   | E    |
| 172     | Range Earth - S/C  | km    | E    |
| 173     | Range Sun - S/C  | km    | E    |
| 174     | Range Sun - Earth  | km    | E    |
| 175     | Range Sun - Jupiter  | km    | E    |

ATTACHMENT E

Navigation Data Block Format for Jupiter Encounter

| WORD | DESCRIPTION   | UNITS | TYPE |
|------|---|-------|------|
| 176  | Range Jupiter - S/C   | km    | E    |
| 177  | Range Jupiter - Io  | km    | E    |
| 178  | Range Jupiter - Europa                                      | km    | E    |
| 179  | Range Jupiter - Ganymede                                    | km    | E    |
| 180  | Range Jupiter - Callisto                                    | km    | E    |
| 181  | Angle Earth - Sun - S/C                                     | deg   | E    |
| 182  | Angle Sun - S/C - Earth (Celestial Cone Angle of Earth)     | deg   | E    |
| 183  | Angle Sun - Earth - S/C                                     | deg   | E    |
| 184  | Angle Jupiter - Sun - S/C                                   | deg   | E    |
| 185  | Angle Sun - S/C - Jupiter (Celestial Cone Angle of Jupiter) | deg   | E    |
| 186  | Angle Sun - Jupiter - S/C                                   | deg   | E    |

ATTACHMENT E

Navigation Data Block Format for Jupiter Encounter

| WORD    | DESCRIPTION  | UNITS | TYPE |
|---------|--|-------|------|
| 187     | Celestial Clock Angle of Earth   | deg   | E    |
| 188     | Celestial Clock Angle of Jupiter   | deg   | E    |
| 189-190 | Celestial Clock and Cone Angles of Io  | deg   | E    |
| 191-192 | Celestial Clock and Cone Angles of Europa  | deg   | E    |
| 193-194 | Celestial Clock and Cone Angles of Ganymede  | deg   | E    |
| 195-196 | Celestial Clock and Cone Angles of Callisto  | deg   | E    |
| 197-198 | Right Ascension and Declination of S/C, Earth Centered, Earth Mean Equator and Equinox of 1950.0     | deg   | E    |
| 199-200 | Right Ascension and Declination of Sun, Earth Centered, Earth Mean Equator and Equinox of 1950.0     | deg   | E    |
| 201-202 | Right Ascension and Declination of Jupiter, Earth Centered, Earth Mean Equator and Equinox of 1950.0 | deg   | E    |
| 203-204 | Right Ascension and Declination of S/C, Jupiter Centered, Jupiter True Equinox and Equator of Date   | deg   | E    |
| 205-206 | Right Ascension and Declination of Sun, Jupiter Centered, Jupiter True Equinox and Equator of Date   | deg   | E    |

ATTACHMENT E

Navigation Data Block Format for Jupiter Encounter

| WORD    | DESCRIPTION  | UNITS        | TYPE |
|---------|--|--------------|------|
| 207-208 | Right Ascension and Declination of Io, Jupiter Centered,<br>Jupiter True Equinox and Equator of Date       | deg          | E    |
| 209-210 | Right Ascension and Declination of Europa, Jupiter Centered,<br>Jupiter True Equinox and Equator of Date   | deg          | E    |
| 211-212 | Right Ascension and Declination of Ganymede, Jupiter Centered,<br>Jupiter True Equinox and Equator of Date | deg          | E    |
| 213-214 | Right Ascension and Declination of Callisto, Jupiter Centered,<br>Jupiter True Equinox and Equator of Date | deg          | E    |
| 215-216 | Celestial Latitude and Longitude of S/C, Sun Centered;<br>Earth True Equinox and Ecliptic of Date          | deg          | E    |
| 217-218 | Celestial Latitude and Longitude of Earth, Sun Centered,<br>Earth True Equinox and Ecliptic of Date        | deg          | E    |
| 219-220 | Celestial Latitude and Longitude of Jupiter, Sun Centered,<br>Earth True Equinox and Ecliptic of Date      | deg          | E    |
| 221-226 | Cartesian State of S/C, Jupiter Magnetic Dipole Centered,<br>Jupiter Magnetic Meridian and Equator of Date | km<br>km/sec | E    |
| 227-232 | Cartesian State of Io, Jupiter Magnetic Dipole Centered,<br>Jupiter Magnetic Meridian and Equator of Date  | km           | E    |
| 233     | Range Jupiter Magnetic Dipole - S/C  | km           | E    |
| 234     | Range Jupiter Magnetic Dipole - Io   | km           | E    |

Navigation Data Block Format for Jupiter Encounter

| WORD    | DESCRIPTION  | UNITS | TYPE |
|---------|--|-------|------|
| 235-236 | Latitude and Longitude of S/C, Jupiter Magnetic Dipole Centered, Jupiter Magnetic Meridian and Equator of Date | deg   | E    |
| 237-238 | Latitude and Longitude of Io, Jupiter Magnetic Dipole Centered, Jupiter Magnetic Meridian and Equator of Date  | deg   | E    |
| 239     | Time to (-) / From (+) Jupiter Periapsis Passage   | sec   | E    |
| 240-252 | Spares   |       |      |
|         |  |       |      |
|         |  |       |      |
|         |  |       |      |
|         |  |       |      |
|         |  |       |      |
|         |  |       |      |
|         |  |       |      |
|         |  |       |      |

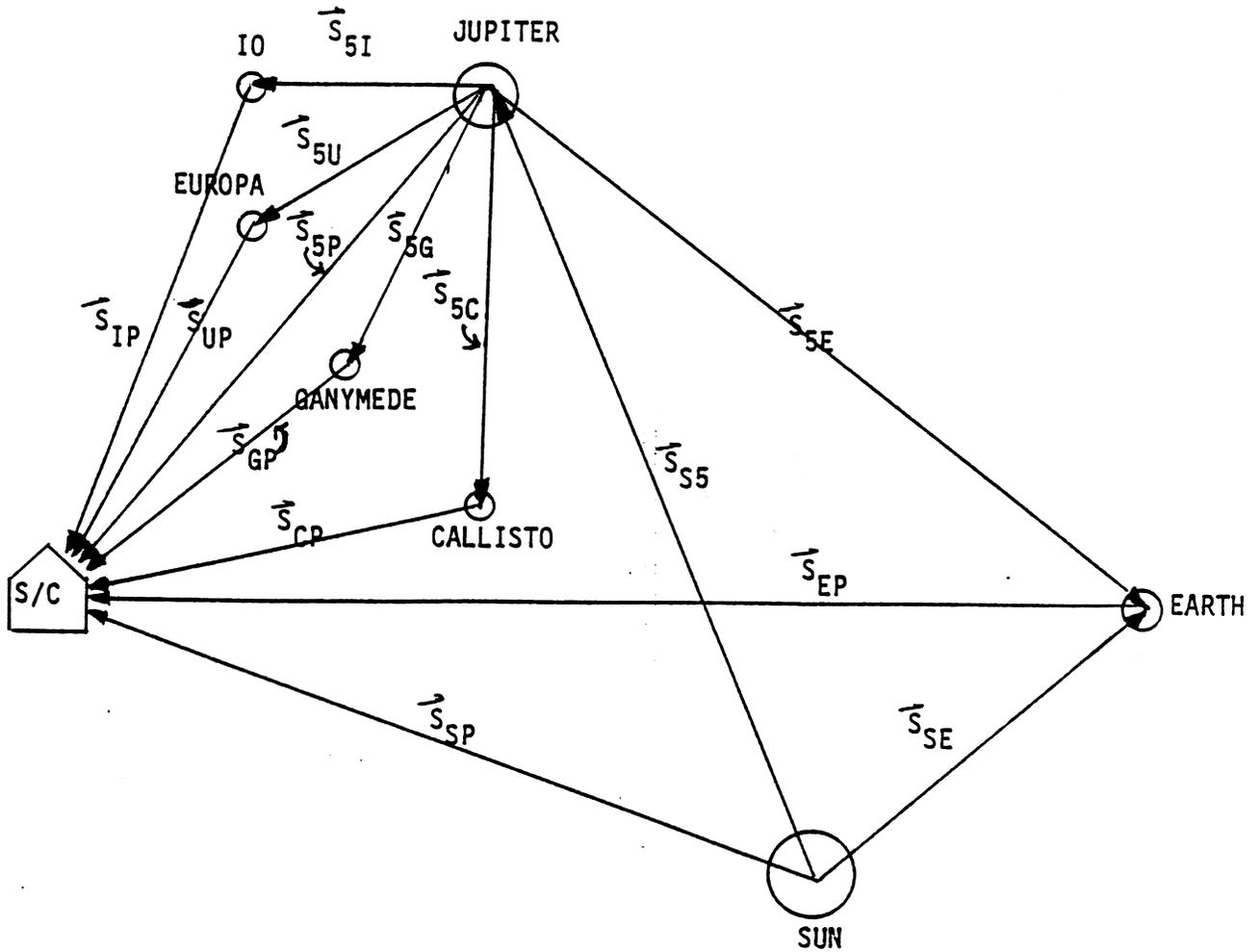


Figure E-1 Earth Mean Ecliptic and Equinox of 1950.0 (ECL50) Jupiter Encounter State Vectors

Nomenclature  $\vec{S}$  refers to State Vector (Position and Velocity Components) with the subscripts AB, where A is the reference or "From" body and B is the "To" body. The following body definitions are used: S-Sun, P-S/C or Probe, E-Earth, 5-Jupiter, I-IO, U-Europa, G-Ganymede, C-Callisto.

**ATTACHMENT F**

**Navigation Data Block Format  
for Saturn Encounter**

## Navigation Data Block Format for Saturn Encounter

| WORD  | DESCRIPTION   | UNITS               | TYPE |
|-------|---|---------------------|------|
| 1     | SCE GMT Year of Navigation Data Block   | years,<br>AD        | I    |
| 2     | SCE GMT Day of Navigation Data Block  | day of<br>year      | I    |
| 3     | SCE GMT Hour of Navigation Data Block   | hour of<br>day      | I    |
| 4     | SCE GMT Minute of Navigation Data Block   | minute<br>of hour   | I    |
| 5     | SCE GMT Second of Navigation Data Block   | second of<br>minute | I    |
| 6     | SCE GMT Millisecond (msec) of Navigation Data Block                                   | msec of<br>second   | I    |
| 7-12  | Cartesian State of S/C, Earth Centered, Earth Mean Ecliptic and<br>Equinox of 1950.0  | km<br>km/sec        | E    |
| 13-18 | Cartesian State of S/C, Sun Centered, Earth Mean Ecliptic and<br>Equinox of 1950.0    | km<br>km/sec        | E    |
| 19-24 | Cartesian State of S/C, Saturn Centered, Earth Mean Ecliptic and<br>Equinox of 1950.0 | km<br>km/sec        | E    |
| 25-30 | Cartesian State of S/C, Titan Centered, Earth Mean Ecliptic and<br>Equinox of 1950.0  | km<br>km/sec        | E    |
| 31-36 | Cartesian State of Earth, Sun Centered, Earth Mean Ecliptic and<br>Equinox of 1950.0  | km<br>km/sec        | E    |

## Navigation Data Block Format for Saturn Encounter

| WORD  | DESCRIPTION  | UNITS        | TYPE |
|-------|--|--------------|------|
| 37-42 | Cartesian State of Saturn, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0               | km<br>km/sec | E    |
| 43-48 | Cartesian State of Earth, Saturn Centered, Earth Mean Ecliptic and Equinox of 1950.0             | km<br>km/sec | E    |
| 49-54 | Cartesian State of Titan, Saturn Centered, Earth Mean Ecliptic and Equinox of 1950.0             | km<br>km/sec | E    |
| 55-60 | Cartesian State of S/C, Saturn Centered, Saturn Mean Orbit and Prime Meridian in Sun Direction   | km<br>km/sec | E    |
| 61-66 | Cartesian State of Titan, Saturn Centered, Saturn Mean Orbit and Prime Meridian in Sun Direction | km<br>km/sec | E    |
| 67-72 | Cartesian State of S/C, Saturn Centered, Saturn True Prime Meridian and Equator of Date          | km<br>km/sec | E    |
| 73-75 | Cartesian Position of Titan, Saturn Centered, Saturn True Prime Meridian and Equator of Date     | km           | E    |
| 76-77 | Saturn Latitude and Longitude of S/C   | deg          | E    |
| 78-79 | Saturn Latitude and Longitude of Titan   | deg          | E    |
| 80    | Range Earth - S/C  | km           | E    |
| 81    | Range Earth - Sun  | km           | E    |

ATTACHMENT F

Navigation Data Block Format for Saturn Encounter

| WORD | DESCRIPTION   | UNITS | TYPE |
|------|---|-------|------|
| 82   | Range Sun - S/C   | km    | E    |
| 83   | Range Saturn - S/C  | km    | E    |
| 84   | Range Titan - S/C   | km    | E    |
| 85   | Range Sun - Saturn  | km    | E    |
| 86   | Range Saturn - Titan                                      | km    | E    |
| 87   | Angle Earth - Sun - S/C                                   | deg   | E    |
| 88   | Angle Sun - S/C - Earth (Celestial Cone Angle of Earth)   | deg   | E    |
| 89   | Angle Sun - Earth - S/C                                   | deg   | E    |
| 90   | Angle Saturn - Sun - S/C                                  | deg   | E    |
| 91   | Angle Sun - S/C - Saturn (Celestial Cone Angle of Saturn) | deg   | E    |
| 92   | Angle Sun - Saturn - S/C                                  | deg   | E    |

## Navigation Data Block Format for Saturn Encounter

| WORD    | DESCRIPTION   | UNITS | TYPE |
|---------|---|-------|------|
| 93      | Celestial Clock Angle of Earth  | deg   | E    |
| 94      | Celestial Clock Angle of Saturn   | deg   | E    |
| 95-96   | Celestial Clock and Cone Angles of Titan  | deg   | E    |
| 97-98   | Right Ascension and Declination of S/C, Earth Centered, Earth Mean Equinox and Equinox of 1950.0    | deg   | E    |
| 99-100  | Right Ascension and Declination of Sun, Earth Centered, Earth Mean Equinox and Equinox of 1950.0    | deg   | E    |
| 101-102 | Right Ascension and Declination of Saturn, Earth Centered, Earth Mean Equinox and Equinox of 1950.0 | deg   | E    |
| 103-104 | Right Ascension and Declination of S/C, Saturn Centered, Saturn True Equinox and Equator of Date    | deg   | E    |
| 105-106 | Right Ascension and Declination of Sun, Saturn Centered, Saturn True Equinox and Equator of Date    | deg   | E    |
| 107-108 | Right Ascension and Declination of Titan, Saturn Centered, Saturn True Equinox and Equator of Date  | deg   | E    |
| 109-110 | Celestial Latitude and Longitude of S/C, Sun Centered, Earth True Equinox and Ecliptic of Date      | deg   | E    |
| 111-112 | Celestial Latitude and Longitude of Earth, Sun Centered, Earth True Equinox and Ecliptic of Date    | deg   | E    |

ATTACHMENT F

Navigation Data Block Format for Saturn Encounter

| WORD    | DESCRIPTION   | UNITS | TYPE |
|---------|---|-------|------|
| 113-114 | Celestial Latitude and Longitude of Saturn, Sun Centered, Earth True Equinox and Ecliptic of Date | deg   | E    |
| 115     | Time To (-) / From (+) Saturn Periapsis Passage   | sec   | E    |
| 116-126 | Spares  |       |      |
|         |   |       |      |
|         |   |       |      |
|         |   |       |      |
|         |   |       |      |
|         |   |       |      |
|         |   |       |      |
|         |   |       |      |
|         |   |       |      |
|         |   |       |      |

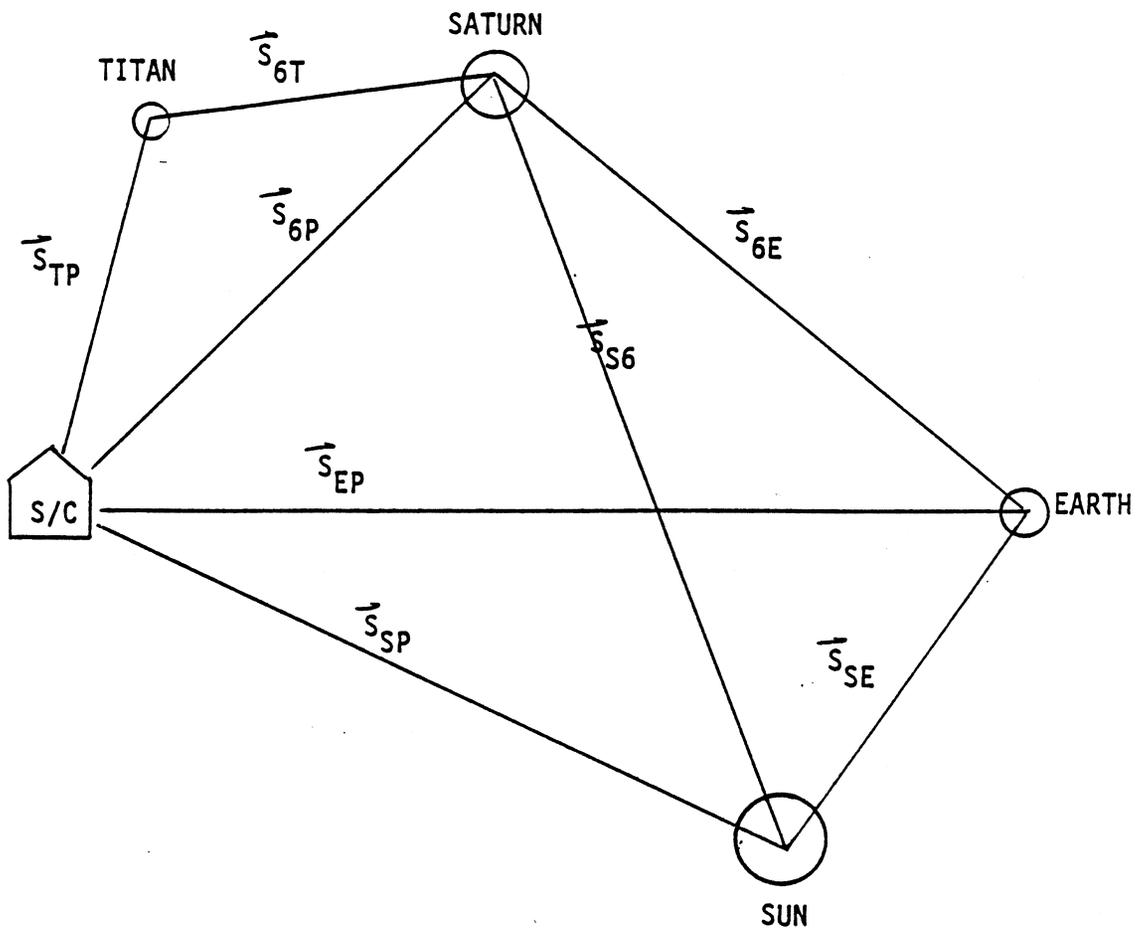


Figure F-1 Earth Mean Ecliptic and Equinox of 1950.0 (ECL50) Saturn Encounter State Vectors

Nomenclature  $\vec{S}$  refers to State Vector (Position and Velocity Components) with the subscripts AB, where A is the reference or "From" body and B is the "To" body. The following body definitions are used: S-Sun, P-S/C or Probe, E-Earth, 6-Saturn, T-Titan.

**ATTACHMENT G**

**Pointing Vector Data  
Block Format**

## Pointing Vector Data Block Format

| WORD | DESCRIPTION   | UNITS               | TYPE |
|------|---|---------------------|------|
| 1    | SCE GMT Year of Pointing Vector Data Block  | years,<br>AD        | I    |
| 2    | SCE GMT Day of Pointing Vector Data Block   | day of<br>year      | I    |
| 3    | SCE GMT Hour of Pointing Vector Data Block  | hour of<br>day      | I    |
| 4    | SCE GMT Minute of Pointing Vector Data Block  | minute<br>of hour   | I    |
| 5    | SCE GMT Second of Pointing Vector Data Block  | second of<br>minute | I    |
| 6    | SCE GMT Millisecond (msec) of Pointing Vector Data Block  | msec of<br>second   | I    |
| 7    | FDSC MOD16 Count Value of Pointing Vector Data Block  | binary<br>counts    | I    |
| 8    | FDSC MOD60 Count Value of Pointing Vector Data Block  | binary<br>counts    | I    |
| 9    | Pitch Limit Cycle Angle (Rotation about the S/C X-Axis with the positive direction determined by the right hand rule) | deg                 | E    |
| 10   | Yaw Limit Cycle Angle (Rotation about the S/C Y-Axis with the positive direction determined by the right hand rule)   | deg                 | E    |
| 11   | Roll Limit Cycle Angle (Rotation about the S/C Z-Axis with the positive direction determined by the right hand rule)  | deg                 | E    |

## Pointing Vector Data Block Format

| WORD  | DESCRIPTION   | UNITS | TYPE |
|-------|---|-------|------|
| 12-14 | Cartesian Unit Vector of the S/C X-Axis, S/C Centered, Earth Mean Ecliptic and Equinox of 1950.0          | dim   | E    |
| 15-17 | Cartesian Unit Vector of the S/C Y-Axis, S/C Centered, Earth Mean Ecliptic and Equinox of 1950.0          | dim   | E    |
| 18-20 | Cartesian Unit Vector of the S/C Z-Axis, S/C Centered, Earth Mean Ecliptic and Equinox of 1950.0          | dim   | E    |
| 21-22 | Celestial Clock and Cone Angles of CRS LET C Boresight  | deg   | E    |
| 23-25 | Cartesian Unit Vector of the CRS LET C Boresight, S/C Centered, Earth Mean Ecliptic and Equinox of 1950.0 | dim   | E    |
| 26-27 | Celestial Clock and Cone Angles of the CRS LET A Boresight  | deg   | E    |
| 28-30 | Cartesian Unit Vector of the CRS LET A Boresight, S/C Centered, Earth Mean Ecliptic and Equinox of 1950.0 | dim   | E    |
| 31-32 | Celestial Clock and Cone Angles of the CRS LET D Boresight  | deg   | E    |
| 33-35 | Cartesian Unit Vector of the CRS LET D Boresight, S/C Centered, Earth Mean Ecliptic and Equinox of 1950.0 | dim   | E    |
| 36-37 | Celestial Clock and Cone Angles of the CRS LET B Boresight  | deg   | E    |
| 38-40 | Cartesian Unit Vector of the CRS LET B Boresight, S/C Centered, Earth Mean Ecliptic and Equinox of 1950.0 | dim   | E    |

ATTACHMENT G

Pointing Vector Data Block Format

| WORD  | DESCRIPTION   | UNITS | TYPE |
|-------|---|-------|------|
| 41-42 | Celestial Clock and Cone Angles of the CRS TET Boresight  | deg   | E    |
| 43-45 | Cartesian Unit Vector of the CRS TET Boresight, S/C Centered, Earth Mean Ecliptic and Equinox of 1950.0     | dim   | E    |
| 46-47 | Celestial Clock and Cone Angles of the CRS HET 1 Boresight  | deg   | E    |
| 48-50 | Cartesian Unit Vector of the CRS HET 1 Boresight, S/C Centered, Earth Mean Ecliptic and Equinox of 1950.0   | dim   | E    |
| 51-52 | Celestial Clock and Cone Angles of the CRS HET 21* Boresight  | deg   | E    |
| 53-55 | Cartesian Unit Vector of the CRS HET 21 Boresight, S/C Centered, Earth Mean Ecliptic and Equinox of 1950.0  | dim   | E    |
| 56-57 | Celestial Clock and Cone Angles of the CRS HET 22* Boresight  | deg   | E    |
| 58-60 | Cartesian Unit Vector of the CRS HET 22 Boresight, S/C Centered, Earth Mean Ecliptic and Equinox of 1950.0  | dim   | E    |
| 61-62 | Celestial Clock and Cone Angles of the LECP Axis of Rotation  | deg   | E    |
| 63-65 | Cartesian Unit Vector of the LECP Axis of Rotation, S/C Centered, Earth Mean Ecliptic and Equinox of 1950.0 | dim   | E    |
| 66-67 | Celestial Clock and Cone Angles of the PLS Axis of Symmetry   | deg   | E    |

\* HET 2, Positions 1 and 2, i.e., HET 21 and HET 22.

ATTACHMENT G

Pointing Vector Data Block Format

| WORD  | DESCRIPTION  | UNITS | TYPE |
|-------|--|-------|------|
| 68-70 | Cartesian Unit Vector of the PLS Axis of Symmetry, S/C Centered, Earth Mean Ecliptic and Equinox of 1950.0.          | dim   | E    |
| 71-72 | Celestial Clock and Cone of the PLS Lateral Detector Boresight   | deg   | E    |
| 73-75 | Cartesian Unit Vector of the PLS Lateral Detector Boresight, S/C Centered, Earth Mean Ecliptic And Equinox of 1950.0 | dim   | E    |
| 76-77 | Celestial Clock and Cone Angles of the HGA Boresight   | deg   | E    |
| 78-80 | Cartesian Unit Vector of the HGA Boresight, S/C Centered, Earth Mean Ecliptic and Equinox of 1950.0                  | dim   | E    |
| 81-82 | Celestial Clock and Cone Angles of the PPS Optic Axis  | deg   | E    |
| 83-85 | Cartesian Unit Vector of the PPS Optic Axis, S/C Centered, Earth Mean Ecliptic and Equinox of 1950.0                 | dim   | E    |
| 86-87 | Celestial Clock and Cone Angles of the UVS Airglow Optic Axis  | deg   | E    |
| 88-90 | Cartesian Unit Vector of the UVS Airglow Optic Axis, S/C Centered, Earth Mean Ecliptic and Equinox of 1950.0         | dim   | E    |
| 91-92 | Celestial Clock and Cone Angles of the UVS Occultation Optic Axis  | deg   | E    |
| 93-95 | Cartesian Unit Vector of the UVS Occultation Optic Axis, S/C Centered Earth Mean Ecliptic and Equinox of 1950.0      | dim   | E    |

Pointing Vector Data Block Format

| WORD    | DESCRIPTION  | UNITS | TYPE  |
|---------|--|-------|-------|
| 96-97   | Celestial Clock and Cone Angles of the IRIS Optic Axis   | deg   | E     |
| 98-100  | Cartesian Unit Vector of the IRIS Optic Axis, S/C Centered, Earth Mean Ecliptic and Equinox of 1950.0                  | dim   | E     |
| 101     | Continuation Bit: = 1, another pointing vector block follows<br>= 0, last pointing vector block in this logical record | dim   | I     |
| 102     | Scan Platform Azimuth Angle  | deg   | E     |
| 103     | Scan Platform Elevation Angle  | deg   | E     |
| 104     | Telemetry Use Code (Octal)*<br>0 = telemetry is NOT used or predict is used<br>1 = telemetry is used                   | NA    | Octal |
| 105-126 | Spares   |       |       |
|         |  |       |       |
|         |  |       |       |
|         |  |       |       |
|         |  |       |       |

\* Refer to Table G-2 for breakdown of telemetry code.

TABLE G-1

Nominal S/C Clock and Cone Angles  
of the Fixed Instrument Boresights

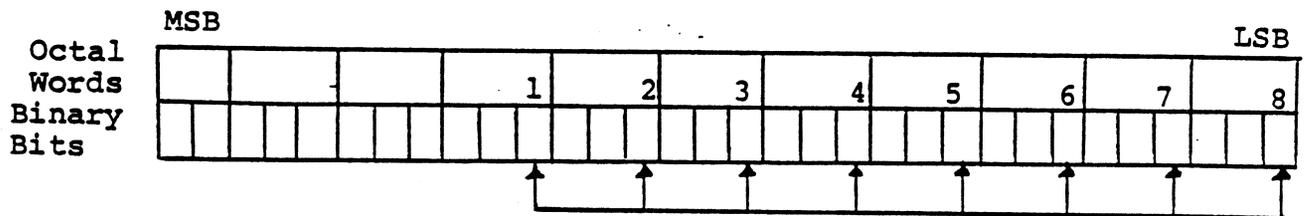
| BORESIGHT             | S/C CLOCK AND CONE ANGLES* |            |
|-----------------------|----------------------------|------------|
|                       | CLOCK (deg)                | CONE (deg) |
| CRS LET A             | 305                        | 115        |
| CRS LET B             | 236                        | 53         |
| CRS LET C             | 125                        | 65         |
| CRS LET D             | 10                         | 48         |
| CRS TET               | 305                        | 115        |
| CRS HET 1             | 338                        | 60         |
| CRS HET 21            | 104                        | 78         |
| CRS HET 22            | 104                        | 140        |
| LECP Axis of Rotation | 200                        | 90         |
| PLS Axis of Symmetry  | ---                        | 0          |
| PLS Lateral Detector  | 262                        | 90         |
| HGA                   | ---                        | 0          |

\* S/C clock and cone angles are not to be confused with celestial clock and cone angles. The S/C clock/cone system uses the HGA boresight and the Canopus Tracker optic axis as references while the celestial clock/cone system uses the Sun and Canopus.

Table G-2  
TELEMETRY USE CODE

| OCTAL NUMBER<br>POSITION -<br>LEFT TO RIGHT | DESCRIPTION                |
|---|----------------------------|
| 1 *   | Pitch Limit Cycle Position |
| 2 *   | Yaw Limit Cycle Position   |
| 3 *   | Roll Limit Cycle Position  |
| 4   | Scan Platform Elevation    |
| 5   | Scan Platform Azimuth      |
| 6   | Pitch Limit Cycle Rate     |
| 7   | Yaw Limit Cycle Rate       |
| 8   | Roll Limit Cycle Rate      |

\* always zero if no limit cycle correction is applied.



When these bits are set telemetry is used.  
When they are not set predicts are used.  
All other bits are zero.

## RIGHT ASCENSION AND DECLINATION ALGORITHM

The PI may wish to compute S/C centered right ascension and declination angles of his boresight or optic axis relative to the Earth Mean Equator and Equinox of 1950.0 (EME50). To obtain these angles the following two step algorithm is offered.

### Step 1. Rotate ECL50 Unit Vector to EME50 Unit Vector

The instrument boresight or optic axis unit vector is available from the SEDR relative to the Earth Mean Ecliptic and Equinox of 1950.0 (ECL50). This unit vector must be rotated through the mean obliquity of the ecliptic (angle between the ecliptic and equatorial planes) at 1950.0 to obtain the EME50 unit vector. The following transformation matrix will accomplish the required rotation.

$$\begin{array}{c} \text{ECL50} \\ \downarrow \\ \text{EME50} \end{array} \quad T \quad = \quad \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos \bar{\epsilon}_0 & -\sin \bar{\epsilon}_0 \\ 0 & \sin \bar{\epsilon}_0 & \cos \bar{\epsilon}_0 \end{bmatrix}$$

Where  $\bar{\epsilon}_0$  is the mean obliquity of the ecliptic at 1950.0 and  $\bar{\epsilon}_0 = 23.445789^\circ$ . The following example illustrates the proper use of this matrix.

$$\vec{U}_{\text{EME50}} = T \begin{array}{c} \text{ECL50} \\ \downarrow \\ \text{EME50} \end{array} * \vec{U}_{\text{ECL50}}$$

Where  $\vec{U}_{\text{EME50}}$  and  $\vec{U}_{\text{ECL50}}$  are the EME50 and ECL50 unit vectors,

respectively, and  $T \begin{array}{c} \text{ECL50} \\ \downarrow \\ \text{EME50} \end{array}$  is the transformation matrix.

Step 2. Compute the Right Ascension and Declination Angles

Once the unit vector has been transformed to EME50 coordinates, the right ascension and declination angles can be computed by using the following equations:

$$\alpha = \text{Tan}^{-1} ( y_{\text{EME50}} / x_{\text{EME50}} )$$

$$\delta = \text{Sin}^{-1} ( z_{\text{EME50}} )$$

Where  $\alpha$  is the right ascension angle,  $\delta$  is the declination angle and  $x_{\text{EME50}}$ ,  $y_{\text{EME50}}$  and  $z_{\text{EME50}}$  are the x, y and z components of the EME50 unit vector.

**Attachment H**

**ATTACHMENT H**

**Fixed Instrument SEIR Format  
Extended Mission Cruise Navigation Block  
Post-Saturn Cruise**

Attachment H

Fixed Instrument SEDR Format  
Extended Mission Cruise Navigation Block

| WORD  | DESCRIPTION   | UNITS             | TYPE |
|-------|---|-------------------|------|
| 1     | SCE GMT Year of Navigation Data Block   | years,<br>AD.     | I    |
| 2     | SCE GMT Day of Navigation Data Block  | day of<br>year    | I    |
| 3     | SCE GMT Hour of Navigation Data Block   | hour of<br>day    | I    |
| 4     | SCE GMT Minute of Navigation Data Block   | minute<br>of day  | I    |
| 5     | SCE GMT Second of Navigation Data Block   | second<br>of min  | I    |
| 6     | SCE GMT Millisecond (msec) of Navigation Data Block                                 | msec of<br>second | I    |
| 7-12  | Cartesian State of S/C, Earth Centered, Earth Mean Ecliptic and Equinox of 1950.0   | km<br>km/sec      | E    |
| 13-18 | Cartesian State of S/C, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0     | km<br>km/sec      | E    |
| 19-24 | Cartesian State of S/C, Uranus Centered, Earth Mean Ecliptic and Equinox of 1950.0  | km<br>km/sec      | E    |
| 25-30 | Cartesian State of S/C, Neptune Centered, Earth Mean Ecliptic and Equinox of 1950.0 | km<br>km/sec      | E    |
| 31-36 | Cartesian State of Earth, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0   | km<br>km/sec      | E    |

Attachment H

Fixed Instrument SEDR Format  
Extended Mission Cruise Navigation Block

| WORD  | DESCRIPTION   | UNITS        | TYPE |
|-------|---|--------------|------|
| 37-42 | Cartesian State of Uranus, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0  | km<br>km/sec | E    |
| 43-48 | Cartesian State of Neptune, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0 | km<br>km/sec | E    |
| 49    | Range Earth - S/C   | km           | E    |
| 50    | Range Earth - Sun   | km           | E    |
| 51    | Range Sun - S/C   | km           | E    |
| 52    | Range Uranus - S/C  | km           | E    |
| 53    | Range Neptune - S/C   | km           | E    |
| 54    | Range Sun - Uranus  | km           | E    |
| 55    | Range Sun - Neptune   | km           | E    |
| 56    | Angle Earth - Sun - S/C   | deg          | E    |
| 57    | Angle Sun - S/C - Earth (Celestial Cone Angle of Earth)                             | deg          | E    |

Attachment H

Fixed Instrument SEDR Format  
Extended Mission Cruise Navigation Block

| WORD  | DESCRIPTION  | UNITS | TYPE |
|-------|--|-------|------|
| 58    | Angle Sun - Earth - S/C  | deg   | E    |
| 59    | Angle Uranus - Sun - S/C   | deg   | E    |
| 60    | Angle Sun - S/C - Uranus (Celestial Cone Angle of Uranus)  | deg   | E    |
| 61    | Angle Sun - Uranus - S/C   | deg   | E    |
| 62    | Angle Neptune - Sun - S/C  | deg   | E    |
| 63    | Angle Sun - S/C - Neptune (Celestial Cone Angle of Neptune)                                      | deg   | E    |
| 64    | Angle Sun - Neptune - S/C  | deg   | E    |
| 65    | Celestial Clock Angle of Earth   | deg   | E    |
| 66    | Celestial Clock Angle of Uranus  | deg   | E    |
| 67    | Celestial Clock Angle of Neptune   | deg   | E    |
| 68-69 | Right Ascension and Declination of S/C, Earth Centered, Earth Mean Equator and Equinox of 1950.0 | deg   | E    |

Attachment H

Fixed Instrument SEDR Format  
Extended Mission Cruise Navigation Block

| WORD   | DESCRIPTION  | UNITS | TYPE |
|--------|--|-------|------|
| 70-71  | Right Ascension and Declination of Sun, Earth Centered, Earth Mean Equator and Equinox of 1950.0     | deg   | E    |
| 72-73  | Right Ascension and Declination of Uranus, Earth Centered, Earth Mean Equator and Equinox of 1950.0  | deg   | E    |
| 74-75  | Right Ascension and Declination of Neptune, Earth Centered, Earth Mean Equator and Equinox of 1950.0 | deg   | E    |
| 76-77  | Right Ascension and Declination of S/C, Uranus Centered, Uranus True Equinox and Equator of Date     | deg   | E    |
| 78-79  | Right Ascension and Declination of Sun, Uranus Centered, Uranus True Equinox and Equator of Date     | deg   | E    |
| 80-81  | Right Ascension and Declination of Earth, Uranus Centered, Uranus True Equinox and Equator of Date   | deg   | E    |
| 82-83  | Spare Words  |       |      |
| 84-85  | Right Ascension and Declination of S/C, Neptune Centered, Neptune True Equinox and Equator of Date   | deg   | E    |
| 86-87  | Right Ascension and Declination of Sun, Neptune Centered, Neptune True Equinox and Equator of Date   | deg   | E    |
| 88-89  | Right Ascension and Declination of Earth, Neptune Centered, Neptune True Equinox and Equator of Date | deg   | E    |
| 90-91* | Celestial Latitude and Longitude of S/C, Sun Centered, Earth True Equinox and Ecliptic of Date       | deg   | E    |

\* Planetocentric latitude

Attachment H

Fixed Instrument SEDR Format  
Extended Mission Cruise Navigation Block

| WORD    | DESCRIPTION  | UNITS        | TYPE |
|---------|--|--------------|------|
| 92-93*  | Celestial Latitude and Longitude of Earth, Sun Centered,<br>Earth True Equinox and Ecliptic of Date  | deg          | E    |
| 94-95*  | Celestial Latitude and Longitude of Uranus, Sun Centered,<br>Earth True Equinox and Ecliptic of Date | deg          | E    |
| 96-97*  | Celestial Latitude and Longitude of Neptune Sun Centered,<br>Earth True Equinox and Ecliptic of Date | deg          | E    |
| 98-99   | Right Ascension and Declination of S/C, Sun Centered, Sun<br>True Equinox and Equator of Date        | deg          | E    |
| 100-101 | Right Ascension and Declination of Earth, Sun Centered, Sun<br>True Equinox and Equator of Date      | deg          | E    |
| 102-103 | Right Ascension and Declination of Uranus, Sun Centered,<br>Sun True Equinox and Equator of Date     | deg          | E    |
| 104-105 | Right Ascension and Declination of Neptune, Sun Centered,<br>Sun True Equinox and Equator of Date    | deg          | E    |
| 106-111 | Cartesian State of Jupiter, Sun Centered, Earth Mean<br>Ecliptic and Equinox of 1950.0               | km<br>km/sec | E    |
| 112-117 | Cartesian State of Saturn, Sun Centered, Earth Mean Ecliptic<br>and Equinox of 1950.0                | km<br>km/sec | E    |
| 118-126 | Spare Words  |              |      |
|         |  |              |      |
|         |  |              |      |

\* Planetocentric latitude

Attachment I

ATTACHMENT I

Fixed Instrument SEDR Format  
Uranus Encounter Navigation Block

Attachment I

Fixed Instrument SEDR Format  
Uranus Encounter Navigation Block

| SEDR WORDS | DESCRIPTION   | UNITS          | TYPE |
|------------|---|----------------|------|
| 1          | SCE GMT Year of Navigation Data Block   | years, AD      | I    |
| 2          | SCE GMT Day of Navigation Data Block  | day of year    | I    |
| 3          | SCE GMT Hour of Navigation Data Block   | hour of day    | I    |
| 4          | SCE GMT Minute of Navigation Data Block   | minute of hour | I    |
| 5          | SCE GMT Second of Navigation Data Block   | second of min  | I    |
| 6          | SCE GMT Millisecond (msec) of Navigation Data Block                               | msec of second | I    |
| 7-12       | Cartesian State of S/C, Earth Centered, Earth Mean Ecliptic and Equinox of 1950.0 | km<br>km/sec   | E    |
| 13-18      | Cartesian State of S/C, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0   | km<br>km/sec   | E    |
| 19-24      | Cartesian State of S/C, Uranus Centered, Earth Mean Ecliptic Equinox of 1950.0    | km<br>km/sec   | E    |
| 25-30      | Cartesian State of S/C, Miranda Centered, Earth Mean Ecliptic Equinox of 1950.0   | km<br>km/sec   | E    |
| 31-36      | Cartesian State of S/C, Ariel Centered, Earth Mean Ecliptic and Equinox of 1950.0 | km<br>km/sec   | E    |

Attachment I

Fixed Instrument SEDR Format  
Uranus Encounter Navigation Block

| SEDR WORDS | DESCRIPTION  | UNITS        | TYPE |
|------------|--|--------------|------|
| 37-42      | Cartesian State of S/C, Umbriel Centered, Earth Mean Ecliptic and Equinox of 1950.0                | km<br>km/sec | E    |
| 43-48      | Cartesian State of S/C, Titania Centered, Earth Mean Ecliptic and Equinox of 1950.0                | km<br>km/sec | E    |
| 49-54      | Cartesian State of Earth, Sun Centered, Earth Mean Ecliptic Equinox of 1950.0                      | km<br>km/sec | E    |
| 55-60      | Cartesian State of Uranus, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0                 | km<br>km/sec | E    |
| 61-66      | Cartesian State of Earth, Uranus Centered, Earth Mean Ecliptic Equinox of 1950.0                   | km<br>km/sec | E    |
| 67-72      | Cartesian State of Miranda, Uranus Centered, Earth Mean Ecliptic and Equinox of 1950.0             | km<br>km/sec | E    |
| 73-78      | Cartesian State of Ariel, Uranus Centered, Earth Mean Ecliptic and Equinox of 1950.0               | km<br>km/sec | E    |
| 79-84      | Cartesian State of Umbriel, Uranus Centered, Earth Mean Ecliptic and Equinox of 1950.0             | km<br>km/sec | E    |
| 85-90      | Cartesian State of Titania, Uranus Centered, Earth Mean Ecliptic and Equinox of 1950.0             | km<br>km/sec | E    |
| 91-96      | Cartesian State of S/C, Uranus Centered, Uranus Mean Orbit and Prime Meridian in Sun Direction     | km<br>km/sec | E    |
| 97-102     | Cartesian State of Miranda, Uranus Centered, Uranus Mean Orbit and Prime Meridian in Sun Direction | km<br>km/sec | E    |

Attachment I

Fixed Instrument SEDR Format  
Uranus Encounter Navigation Block

| SEDR WORDS | DESCRIPTION  | UNITS        | TYPE |
|------------|--|--------------|------|
| 103-108    | Cartesian State of Ariel, Uranus Centered, Uranus Mean Orbit and Prime Meridian in Sun Direction   | km<br>km/sec | E    |
| 109-114    | Cartesian State of Umbriel, Uranus Centered, Uranus Mean Orbit and Prime Meridian in Sun Direction | km<br>km/sec | E    |
| 115-120    | Cartesian State of Titania, Uranus Centered, Uranus Mean Orbit and Prime Meridian in Sun Direction | km<br>km/sec | E    |
| 121-126    | Cartesian State of S/C, Uranus Centered, Uranus True Prime Meridian and Equator of Date            | km<br>km/sec | E    |
| 127-129    | Cartesian Position of Miranda, Uranus Centered, Uranus True Prime Meridian and Equator of Date     | km           | E    |
| 130-132    | Cartesian Position of Ariel, Uranus Centered, Uranus True Prime Meridian and Equator of Date       | km           | E    |
| 133-135    | Cartesian Position of Umbriel, Uranus Centered, Uranus True Prime Meridian and Equator of Date     | km           | E    |
| 136-138    | Cartesian Position of Titania, Uranus Centered, Uranus True Prime Meridian and Equator of Date     | km           | E    |
| 139-140    | Uranus Latitude*, Longitude of S/C   | deg          | E    |
| 141-142    | Uranus Latitude*, Longitude of Miranda   | deg          | E    |
| 143-144    | Uranus Latitude*, Longitude of Ariel   | deg          | E    |

Attachment I

Fixed Instrument SEDR Format  
Uranus Encounter Navigation Block

| SEDR WORDS | DESCRIPTION                            | UNITS | TYPE |
|------------|--|-------|------|
| 145-146    | Uranus Latitude*, Longitude of Umbriel | deg   | E    |
| 147-148    | Uranus Latitude*, Longitude of Titania | deg   | E    |
| 149        | Range Earth - S/C                      | km    | E    |
| 150        | Range Sun - S/C                        | km    | E    |
| 151        | Range Sun - Earth                      | km    | E    |
| 152        | Range Sun - Uranus                     | km    | E    |
| 153        | Range Uranus - S/C                     | km    | E    |
| 154        | Range Uranus - Miranda                 | km    | E    |
| 155        | Range Uranus - Ariel                   | km    | E    |
| 156        | Range Uranus - Umbriel                 | km    | E    |
| 157        | Range Uranus - Titania                 | km    | E    |

Attachment I

Fixed Instrument SEDR Format  
Uranus Encounter Navigation Block

| SEDR WORDS | DESCRIPTION   | UNITS | TYPE |
|------------|---|-------|------|
| 158        | Angle Earth - Sun - S/C                                   | deg   | E    |
| 159        | Angle Sun - S/C - Earth (Celestial Cone Angle of Earth)   | deg   | E    |
| 160        | Angle Sun - Earth - S/C                                   | deg   | E    |
| 161        | Angle Uranus - Sun - S/C                                  | deg   | E    |
| 162        | Angle Sun - S/C - Uranus (Celestial Cone Angle of Uranus) | deg   | E    |
| 163        | Angle Sun - Uranus - S/C                                  | deg   | E    |
| 164        | Celestial Clock Angle of Earth                            | deg   | E    |
| 165        | Celestial Clock Angle of Uranus                           | deg   | E    |
| 166-167    | Celestial Clock and Cone Angles of Miranda                | deg   | E    |
| 168-169    | Celestial Clock and Cone Angles of Ariel                  | deg   | E    |
| 170-171    | Celestial Clock and Cone Angles of Umbriel                | deg   | E    |

Attachment I

Fixed Instrument SEIR Format  
Uranus Encounter Navigation Block

| SEIR WORDS | DESCRIPTION  | UNITS | TYPE |
|------------|--|-------|------|
| 172-173    | Celestial Clock and Cone Angles of Titania   | deg   | E    |
| 174-175    | Right Ascension and Declination of S/C, Earth Centered, Earth Mean Equator and Equinox of 1950.0     | deg   | E    |
| 176-177    | Right Ascension and Declination of Sun, Earth Centered, Earth Mean Equator and Equinox of 1950.0     | deg   | E    |
| 178-179    | Right Ascension and Declination of Uranus, Earth Centered, Earth Mean Equator and Equinox of 1950.0  | deg   | E    |
| 180-181    | Right Ascension and Declination of S/C, Uranus Centered, Uranus True Equinox and Equator of Date     | deg   | E    |
| 182-183    | Right Ascension and Declination of Sun, Uranus Centered, Uranus True Equinox and Equator of Date     | deg   | E    |
| 184-185    | Right Ascension and Declination of Miranda, Uranus Centered, Uranus True Equinox and Equator of Date | deg   | E    |
| 186-187    | Right Ascension and Declination of Ariel, Uranus Centered, Uranus True Equinox and Equator of Date   | deg   | E    |
| 188-189    | Right Ascension and Declination of Umbriel, Uranus Centered, Uranus True Equinox and Equator of Date | deg   | E    |
| 190-191    | Right Ascension and Declination of Titania, Uranus Centered, Uranus True Equinox and Equator of Date | deg   | E    |
| 192-193    | Celestial Latitude* and Longitude of S/C, Sun Centered, Earth True Equinox and Ecliptic of Date      | deg   | E    |

\* Planetocentric latitude

